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ABSTRACT

HARPER, DOUGLAS GENE, Supplier Alliances for Engineered Equipment in Capital Projects. (Under the direction of Leonhard E. Bernold.)

Energy sector capital projects typically cost hundreds of millions and even billions of dollars to design, engineer, procure and construct. Major components of these projects are engineered capital equipment that the facility is built around. Managing the engineered equipment is important during all phases of the project not only because of their high dollar value but also because the long manufacturing lead times often drive the overall project schedules. Procurement of engineered equipment has traditionally been done using lowest technically qualified bid. Supplier selection decisions are made in which there is lost opportunity due to failures by the buying organizations to capitalize on and integrate the suppliers' detailed knowledge about the engineered equipment they produce. One method that has potential to eliminate this barrier is supplier alliances.

To create a basis for an in depth evaluation of supplier alliances, a literature review was accomplished to evaluate other industries on a global scale. Opportunities and barriers for supplier alliances in capital projects were identified using a questionnaire and a series of interviews that included 16 companies representing different groups involved in capital projects. Opportunities were evaluated based on criteria involving cost, time, and quality. Questionnaire results and personal interviews with industry executives reveal that time savings and quality improvements were perceived to be of much greater value than the initial price savings of the engineered equipment from supplier alliances. Industry experts estimated that supplier alliance initial price savings

would range from six to ten percent while procurement time savings of up to six months could be achieved by eliminating the bidding cycle for engineered equipment. However, by far the highest added value would arise from better capitalizing on the suppliers' specialized expertise about the equipment.

Based on the result of the extensive surveys, a Capital Projects Supplier Alliance Model (CaPSAM) was developed consisting of several integrated modules lead by a Company Self-Assessment which suggests a procedure where a company assesses its own management culture toward alliances. The model follows the life cycle of the alliance from development through management to include establishing metrics to measure performance.

It is generally understood that supplier alliances do not provide a blanket solution for procuring engineered equipment items. A source of caution is broad industry studies showing that most alliances end in failure. Most surprising was the fact that very few companies use metrics to measure performance, thus leaving them in the dark on the question why an alliance failed. Based on the final analysis of the present situation, it is felt that the most critical contribution of this work is the CaPSAM which incorporates not only the key factors that made supplier alliances successful in other industries, but also measures to avoid pitfalls. Since synergy leads to better performance, effectively managed supplier alliances are predestined to offer substantive value/benefits to all participants.

**Supplier Alliances for Engineered Equipment
in Capital Projects**

by

DOUGLAS GENE HARPER

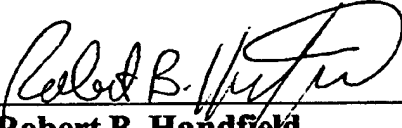
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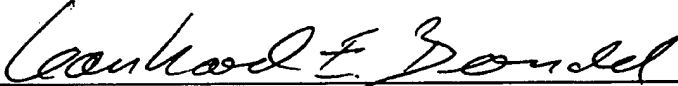
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Robert B. Handfield



William J. Rasdorf



Leonhard E. Bernold
Chair of Advisory Committee

DEDICATION

To my wife, sons and dog who have given more to this paper not only through their love and support, but also for spending weekends at “Camp Granda and Pop” without me so that I could finish this thesis! I love you all!

To my parents who are still there for me even now that I have my own kids.

To David Timberlake with Bechtel Corporation whose expert advise on this subject matter was invaluable. His numerous reviews of questionnaires and draft reports were greatly appreciated.

For those who lost their lives and the loved ones left behind from the September 11th terrorist attacks and the Iraq War. My graduate career started a few weeks before the terrorist attacks on the U.S. on September 11, 2001, when 2,998 victims lost their lives. It will conclude a few weeks following the liberation of Iraq where 176 military personnel made the ultimate sacrifice for freedom as of May 8, 2003.

BIOGRAPHY

Doug Harper is a military officer in the U.S. Air Force pursuing full-time graduate work in construction engineering and business administration (MBA). He currently holds the military rank of Major. Prior to his graduate work, he spent 11 years as the owner's (Air Force Surgeon General) representative on the design and construction of medical facilities. His career has included several management and consultative positions in design and construction to include: program design and construction manager responsible for the design development and program budget submission for 26 medical projects valued at \$193 million; on-site construction medical project manager for a \$42 million hospital in England; and medical facilities consultant. Following his graduate studies, he will resume his duties with the Air Force Health Facilities Division.

He holds a B.S. degree in Civil Engineering from the Virginia Military Institute (VMI).

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The U.S. Air Force has given me the opportunity to expand my knowledge by attending graduate school. I hope to use this knowledge in my future contributions to maintaining the world's premier air and space force.

I would like to thank Dr. Steve Allen, Director of the MBA Program and Dr. David Johnston, Director of the Civil Engineering Graduate Programs for supporting my dual masters' degrees in construction engineering and business (MBA).

I wish also to thank my advisory committee. Dr. Bernold who has given me the motto: "There is always a better way to do construction." Dr. Handfield has been extremely supportive in teaching me about supply chain management and helping me to work with Bechtel Corporation through the Supply Chain Resource Consortium. Dr. Rasdorf has provided insights that I was unable to attain in the classroom due to scheduling conflicts that caused me to miss out on his class. Mr. David Timberlake, the unofficial committee member with Bechtel has shared invaluable knowledge based on his industry experience.

The following companies and more importantly their people have shared their know-how about procuring engineered equipment for capital projects and their experiences with supplier alliances. Their input has added lessons learned from real world experiences that enrich the information discovered in the literature review. Thank you for sharing your time and insights about this subject.

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TABLE OF CONTENTS

LIST OF TABLES	viii
LIST OF FIGURES	ix
1 Introduction	1
1.1 EPC Contractor Industry	2
2 Literature Review	6
2.1 Owner-Contractor-Supplier Relationship	6
2.2 Construction Industry Alliance	8
2.3 The Nature of Alliances	9
2.3.1 Alliances	9
2.3.2 Project Alliances	10
2.3.3 Joint Ventures	10
2.3.4 Partnering	11
2.3.5 Framework Agreements	11
2.3.6 Alliance Groups (Networks)	11
2.4 Spectrum of Cooperative Business Arrangements	13
2.4.1 Strategic vs Tactical	15
2.4.2 Horizontal vs. Vertical Alliances	15
2.4.3 Alliance Models	16
2.5 Alliance Red Flags	16
2.6 Alliances in Engineering and Construction	19
2.7 Alliance Examples in Capital Projects	21
2.7.1 Chevron-Texaco/Solar Turbines Alliance	21
2.7.2 BP Andrew Field	22
2.7.3 Sasol	22
3 Research Plan	24
3.1 Problem Statement	24
3.2 Objectives	24
3.3 Methodology	25
3.4 Participants	28
3.5 Data Analysis	29
4 Capital Projects Supplier Alliance Model (CaPSAM)	31
4.1 Company Self Assessment	32
4.1.1 Teams	35
4.1.2 Alliance Management Function	36
4.2 Business Case	37
4.2.1 Major Equipment Identification	38
4.2.2 Potential Benefits	40
4.2.3 Possible Barriers	45
4.2.4 Strength of Relationships	47
4.2.5 Economic Considerations	50
4.3 Supply Base Management	50
4.3.1 Number of Suppliers in a Major Equipment Alliance	51

4.3.2	Exclusive Agreements	52
4.3.3	Selection.....	52
4.4	Alliance Framework.....	55
4.4.1	Establishing Goals for the Alliance	55
4.4.2	Defining the Alliance Scope	58
4.4.3	Key Aspects	60
4.4.3.1	Terms & Conditions.....	61
4.4.3.2	Standard Specifications.....	61
4.4.3.3	Cost Sharing.....	62
4.4.3.4	Target Costing (Pricing)	63
4.4.3.5	Total Cost of Ownership (TCO)	64
4.4.3.6	Contract Duration (Long-term contracts)	65
4.4.3.7	Litigation and Dissolution:	66
4.5	Alliance Management and Metrics	66
4.5.1	Metrics	68
5	Summary, Conclusions and Recommendations	73
5.1	Summary	73
5.2	Conclusions.....	74
5.3	Recommendations.....	75
6	References	78
	APPENDIX A QUESTIONNAIRE	83
	APPENDIX B INTERVIEW QUESTIONS	92

LIST OF TABLES

Table 3-1 Survey Statistics	30
Table 4-1 Alliance Partner Selection Criteria	54
Table 4-2 Traditional Construction Costing and Targeting Costing compared.....	64
Table 4-3 CAPS Research Procurement Performance Measures for Engineering and Construction.....	71
Table 4-4 Alliance Scorecard Metrics	72

LIST OF FIGURES

Figure 1-1 Revenue, ENR Top 225 International Contractors	3
Figure 1-2 Profitability, ENR Top 225 International Contractors”	3
Figure 2-1 Extended Enterprise Segmentation	14
Figure 2-2 Cooperative Arrangements.....	15
Figure 2-3 Comparison of Alliance Models	17
Figure 2-4 CAPS Research Industry Data by Sales	20
Figure 2-5 CAPS Research Data by Alliances	20
Figure 2-6 CAPS Research Data by Major Suppliers.....	21
Figure 4-1 CaPSAM	32
Figure 4-2 Sourcing Tactics	39
Figure 4-3 Capital Projects Timeline.....	42
Figure 4-4 Project phases that supplier integration would improve	43
Figure 4-5 Supplier Integration Cost Savings.....	44
Figure 4-6 Barriers to Supplier Integration.....	46
Figure 4-7 Strength of Relationships	47
Figure 4-8 Quality Benefits of Supplier Integration.....	57
Figure 4-9 Capital Projects Alliance Spectrum	59
Figure 4-10 Performance Factors.....	69
Figure 4-11 Balanced Scorecard.....	72
Figure 5-1 Alliance Tools	76

1 Introduction

Energy sector capital projects typically cost hundreds of millions and even billions of dollars to design, engineer, procure and construct. Major component of these projects are engineered capital equipment that the facility is built around. Managing the engineered equipment is important during all phases of the project not only because of their high dollar value but also because the long manufacturing lead times often drive the overall project schedules. A report from a turbomachinery symposium noted that mechanical equipment commonly accounts for 25 to 35 percent of the capital investment in a new petroleum project.¹ An executive interviewed for this project from the petroleum market also commented that there are five major equipment item categories on a liquefaction natural gas (LNG) plant that account for 25 percent of the total project cost and represents 50 percent of the materials and equipment budget.

Procurement of engineered equipment has traditionally been done using the lowest technically qualified bid process. Supplier selection decisions are made in which there is lost opportunity due to failures by the buying organizations to capitalize on and integrate the suppliers' detailed knowledge about the engineered equipment they produce. One method that has potential to eliminate this barrier is supplier alliances.

It is generally understood that supplier alliances do not provide a blanket solution for procuring engineered equipment items. In fact, various consulting firms estimate that between 40 to 50 percent of all types of alliances are considered failures.^{2,3} They have also found that only 51 percent of alliances have any metrics to evaluate their performance.⁴

1.1 EPC Contractor Industry

The building of large-scale capital projects in the energy market sector is typically accomplished by engineer, procurement, construction (EPC) contractors that can provide a full-range of services. In 2002, the global construction market was approximately \$3.5 trillion.⁵ In the U.S., the construction industry contributed \$480 billion to the gross domestic product (GDP) in 2001.⁶ Construction represented 4.8 percent of the 2001 GDP.⁷ In 2001, the "ENR Top 225 International Contractors" generated almost \$400 billion in combined revenue from international (\$102 billion) and domestic (\$295 billion) work for capital projects.⁸ The Top 225 International Contractors included 134 U.S. companies; however, only 51 had any reported international revenue. The U.S. companies reported \$114 billion in domestic revenue and \$21 billion in international revenue for a combined total of \$135 billion. U.S. firms had 21 percent of the international market share. The average profit margin for the ENR Top 225 firms was 7.0 percent for international work located outside their home country and 7.2 percent for domestic work.⁹ A review of the ENR Top 225 International Contractors over the last several years reveals that revenue has been flat (Figure 1-1). The dip in 2001 is partly due to the bankruptcy of a German firm and a merger of two Dutch firms.¹⁰ Although profits have been erratic over this time period, the general trend has been positive (Figure 1-2).

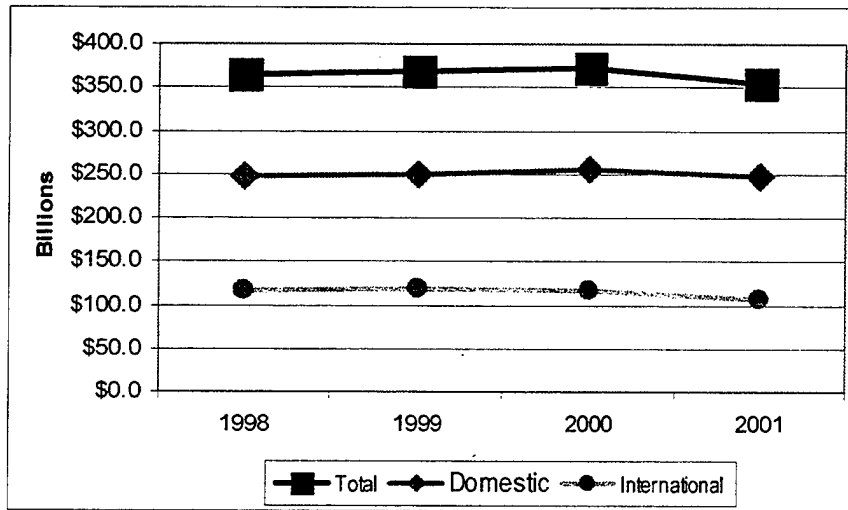


Figure 1-1 Revenue, ENR Top 225 International Contractors

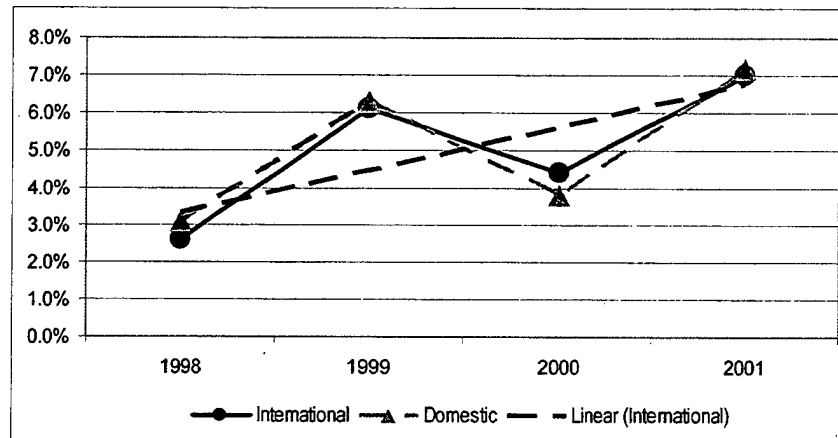


Figure 1-2 Profitability, ENR Top 225 International Contractors^{11,12,13,14}

The first wave of globalization occurred with the buyout of some major U.S. construction firms by foreign owners. Some examples include:

- Hochtief (Germany) acquisition of Turner Construction in 1999¹⁵
- Skanska's (Sweden) acquisition of Beers Brothers Construction in 1994¹⁶

- ABB (Sweden) acquisition of Combustion Engineering (including subsidiary Lummus Crest) in 1989¹⁷
- Bilfinger Berger (Germany) acquisition of Fru-Con in 1984¹⁸

Industry reorganization has also occurred in other international EPC firms to include:

- Bankruptcy of Phillip Holzmann, the largest German EPC contractor in 2002.¹⁹
- The merger of several French EPC contractors in 2000 to form the Vinci Group, the current #1 EPC contractor on the ENR Top 225 List.²⁰
- The merger of Raytheon engineers and constructors with the Washington Group (who had bought out Morrison Knudsen in 1996) in 2000.²¹
- The merger of Bovis (U.K.) and Lend Lease (Australia) to form Bovis Lend Lease in 1999.²²
- The Shaw Group, primarily a supplier, acquiring Stone & Webster EPC contractor in 1999.²³
- The merger of M.W. Kellogg (parent company Dresser Industries) and Brown & Root (parent company Halliburton) in 1998 with the merger of their parent companies.²⁴

During this study, several respondents noted a second wave of globalization with engineering services moving to lower cost off-shore locations. A recent Business Week cover story about globalization noted that Fluor, a leading EPC contractor, is using a work-force of 200 engineers and draftsman in the Philippines to collaborate with U.S. and British engineers to design a multi-million dollar petrochemical plant in Saudi Arabia using web portals. The Filipino engineers make less than \$3,000 a year versus their U.S.

and British counterparts that make up to \$90,000. Fluor's CEO, Alan Boeckmann, says the Philippines operation helps Fluor cut up to 15% off project prices. He says that Fluor has "developed this into a core competitive advantage."²⁵ Clearly, the trend toward the outsourcing of engineering manhours to lower cost areas by EPC contractors will continue to grow. If U.S. firms are to remain competitive, a new way of doing business and perhaps one that embraces the concepts of strategic alliances with suppliers must occur. The concepts of supplier alliances are discussed in this report after a brief overview of the literature.

2 Literature Review

In order to establish a thorough understanding of the various aspects of the problem, several issues were reviewed. First, past research on procurement of engineering equipment and alliances in construction was reviewed. Secondly, the numerous types of alliances and their definitions and structure were reviewed. This search also included other alliance models that have been developed. Finally, a general picture of alliances in the engineering and construction industry and some alliance examples in capital projects were examined.

2.1 Owner-Contractor-Supplier Relationship

The Construction Industry Institute (CII) investigated the traditional relationships between the Owner, EPC Contractor, and Supplier to develop an alternative method to procure major equipment items for capital projects. Their research defined a new procurement model called "PEpC." This reflected their findings that procurement of major equipment items, identified with a capital "P," should occur before engineering and the procurement of minor equipment items, represented by a lower case "p," should follow the traditional EPC process. They noted that capital "P" procurement should not be confused with the early purchasing of major equipment used in the traditional EPC method to ensure project scheduling. They stressed that PEpC was more than just a scheduling technique but also a method to integrate suppliers into the project design so that their expertise could be incorporated into the project.

The PEpC process was developed using literature search, questionnaires, and interviews with CII industry participants. The benefits of this process were determined using 10 computer simulations of the EPC process and four capital projects with PEpC style characteristics. The study results stated that, "PEpC could produce savings in excess of 10 to 15 percent of the time and savings of four to eight percent of the cost of the traditional EPC process."²⁶ Other suggested benefits from the PEpC process include:

- Improved quality of the detail design.
- Improved system and facility performance.
- Earlier deployment of new technologies.
- More equitable allocation of risk.
- Improved utilization of supplier core competencies.
- Reduction or elimination of redundant work processes.
- Diminished need for owners or contractors to maintain non-core competencies that are more effectively maintained and delivered by suppliers.²⁷

The PEpC research tackled questions surrounding alliances and best price. The report concludes that the PEpC process does not require strategic alliances or partnering relationships to be implemented. The key step is for certain major equipment items to be procured before detailed engineering. Major equipment items would be procured based on conceptual designs, performance specifications or supplier service concepts instead of low bid evaluation based on detailed specifications. Major equipment items selected using the PEpC process would be evaluated based on more comprehensive, total value

criteria that would also consider the suppliers' expertise and the value-added solutions that they can bring to the project, not just lowest price. They state that competitive bidding does not have to be abandoned, but rather "that the basis of competition should be on a broader and more conceptual basis focusing on a supplier's ability to deliver greater value to the project rather than simply lower price."²⁸ The summary goes on to describe some of the negative aspects of competitive bidding such as over specification which limits the input of supplier knowledge in meeting the customer's requirements.

2.2 Construction Industry Alliance

The CII research also conducted a much broader study on international alliances for the construction industry. They categorized the benefits of alliances into three major groups dealing with marketing, project execution, and organization. A benefit in the project execution group included supplier alliances. The report states:

"Forming alliances with material suppliers can ensure consistent quality, reduce cost, and improve delivery. This becomes increasingly important as customers demand compressed project schedules."²⁹

The report also identifies characteristics of a well structured alliance:

- The alliance produces a comfortable atmosphere built on trust.
- The purpose of the alliance is clear.
- Cooperative spirit exists among alliance partners.
- The risks are identifiable and affordable.
- The alliance complements the strengths of each partner.³⁰

The alliance model developed by the researchers consisted of five phases: (1) Define the alliance; (2) Develop goals and mission; (3) Identify challenges and obstacles; (4) (Establish) Measurement criteria; and (5) Identify responsibilities. One challenge identified was purchasing procedures. A suggested solution was to use cross functional teams consisting of engineering, construction, and procurement members. They also pointed out that alliances work best when the parties have established trust and confidence in each other.

2.3 The Nature of Alliances

Booz-Allen & Hamilton noted that, "more than 20,000 new alliances were formed in the U.S. between 1987 and 1992, compared with 5,100 between 1980 and 1987 and 750 during the 1970s."³¹ Grikscheit and Cag searched business news databases and "found approximately 6,000 articles on alliance formation in 1998; 9,000 in 1999; 16,000 in 2000; and 9,000 in 2001."³²

The following provides a simple review of alliances that can be found today.

2.3.1 Alliances

CII defines alliances as,

"a long-term association with a non-affiliated organization, used to further the common interests of the members. The continued association is based upon mutual trust and the satisfactory performance of each participant, and the alliance as a whole, rather than a pure contractual obligation."³³

The consulting firm of Booz-Allen & Hamilton notes that,

“a strategic alliance (is) a cooperative arrangement between two or more companies where:

- A common strategy is developed in unison and a win-win attitude is adopted by all parties.
- The relationship is reciprocal, with each partner prepared to share specific strengths with each other, thus lending power to the enterprise.
- A pooling of resources, investment, and risk occurs for mutual (rather than individual) gain.”³⁴

Kanter research identified three fundamental aspects of business alliances:

- “They must yield benefits for the partners, but they are more than just the deal.
- Alliances that both partners ultimately deem successful involve collaboration (creating new value together) rather than mere exchange (getting something back for what you put in).
- They cannot be “controlled” by formal systems but require a dense web of interpersonal connections and internal infrastructure that enhance learning.”³⁵

Monczka, et al define collaboration as,

“... the process where by which two or more parties adopt a high level of purposeful cooperation to maintain a trading relationship over time.”³⁶

2.3.2 Project Alliances

The Australian CII defines project alliances as:

- “an agreement between two or more entities which undertake to work cooperatively, on the basis of sharing of project risk and reward, for the purpose of good faith and trust and an open-book approach towards costs.
- a joint commitment where parties agree their contribution levels and required profit beforehand and then place these at risk.
- If one party in the alliance under-performs then all other partners are at risk of losing their rewards (profit and incentives) and could even share losses according to the agreed project painsharing/gainsharing model.”³⁷

2.3.3 Joint Ventures

“A joint venture is a collaborative undertaking by two or more participants for a specific purpose. The participants are obligated by contractual

agreement to contribute skills, experience, financing, and physical resources.”³⁸

2.3.4 Partnering

The classic CII definition for partnering is,

“a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant’s resources. The relationship is based on trust, dedication to common goals, and an understanding of each other’s individual expectations and values.”³⁹

Hobbs and Anderson distinguish Partnering from Frame(work) agreements based on time of implementation in the project schedule and the number of projects covered. Partnering is an arrangement typically between the Owner and the EPC contractor that is implemented after the construction contract has been competitively bid. There is no (limited) opportunity for the EPC contractor or Supplier to have input on the design. Partnering is typically associated with a single project focus whereas frame (work) agreements are long-term, multi-project agreements.⁴⁰

2.3.5 Framework Agreements

“Framework agreements are a useful tool for implementing long term relationships. An outline contractual framework is established, agreeing terms, scope of coverage, basis of pricing, usually year-on-year improvement targets, and expected medium term volumes of work. When goods or services are required, all that is normally required is a price – (therefore,) tendering (bidding) times are significantly reduced.”⁴¹

2.3.6 Alliance Groups (Networks)

Gomes-Casseres defines alliance groups as, “a collection of separate companies linked through collaborative agreements.”⁴² He states that all companies in a group do

not have to be directly linked to each other. He notes that alliance groups are more focused on a strategic purpose and the roles of their members more narrowly tailored than Japanese keiretsus (or Korean chaebols) where the relationship is more broad-based. A keiretsus is described as,

“a loose conglomeration of companies organized around a single bank for their mutual benefit. The companies sometimes, but not always, own equity in each other.”⁴³

Chaebols are defined as,

“a conglomerate of many companies clustered around one parent company. The companies usually hold shares in each other and are often run by one family.”⁴⁴

Alliance groups are also much different from cartels which try to allocate world markets and suppress competition. Alliance groups are typically comprised of more than one group competing in a given industry. The Gomes study reviewed four alliance groups working at that time (circa 1987 – 1991) to develop new computer chip technology (RISC – reduced instruction set computer). Today, there is similar alliance competition for wireless (WiFi) internet networks. In December 2002, IBM, Intel, and AT&T formed a joint venture, Cometa, to build a wireless network. Other groups including Starbucks and T-Mobile and Boingo Wireless working with local internet providers are also competing in the growing Wi-Fi market.⁴⁵

Gordon’s study of alliance groups in shipbuilding notes that,

“although competition will continue to exist, the new model of business will mean competition between groups of closely aligned firms rather than (competition) among individual organizations competing independently.”⁴⁶

CAPS Research's Shipbuilding Industry Report noted that 63 percent of shipbuilding companies surveyed "participate in multi-company buying cooperatives/consortia" and that the, "average number of multi-company buying cooperatives/consortias with whom companies are involved" was 21.⁴⁷ One example consortia buying group is Sea Supplier that was formed in 2001 and has a \$1 billion spend on spares and consumables. They claim to have reduced unit cost by 20-40 percent.⁴⁸

2.4 Spectrum of Cooperative Business Arrangements

Alliances span a broad range of cooperative relationship arrangements between companies. The consulting firm of Booz-Allen & Hamilton has developed a chart showing different cooperative relationship types based on the strength of commitment and ownership levels.⁴⁹ Commitment levels range from none, viewing the relationship as transactional, to long-term and permanent. Ownership levels also range from none to sharing of information, resources, funding, and equity, to being wholly owned in an acquisition. In the Booz-Allen & Hamilton model, alliances fall between numerous sourcing strategies; i.e. commodity purchase order and strategic sourcing and acquisitions. Alliances are characterized by long term commitments and a sharing of

resources. See Figure 2-1 for an adapted version of the Booz-Allen & Hamilton model.

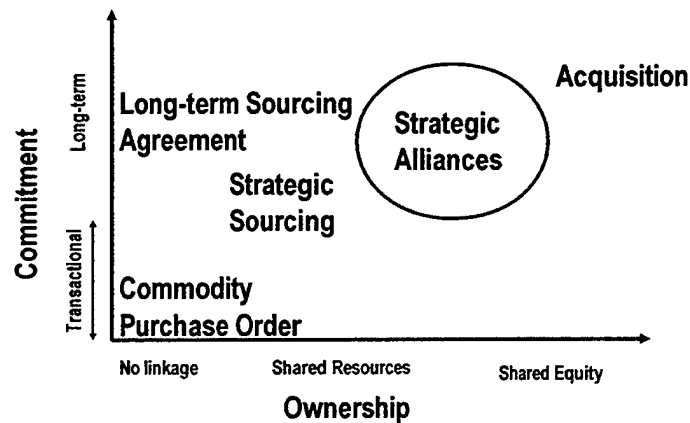


Figure 2-1 Extended Enterprise Segmentation⁵⁰

Kanter quantifies the spectrum of cooperative business arrangements on a single “continuum from weak and distant to strong and close.”⁵¹ The lower end consists of “mutual service consortia” represented by companies of similar industries that pool their resources together to achieve a desired benefit such as access to an advanced technology. In the mid-range are “joint ventures” that combine the strength from one company to overcome the weakness in another company. The strongest relationship forms are “value-chain partnerships” typified by supplier-customer relationships. This is the type of arrangement that is achieved with integrating suppliers with either owners or EPC contractors in the capital projects process. See Figure 2-2 for a graphical representation of this model.

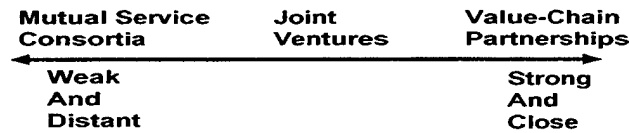


Figure 2-2 Cooperative Arrangements⁵²

2.4.1 Strategic vs Tactical

Grikscheit and Cag simply state that strategic alliances must be formed to meet the companies' strategic purposes.⁵³ They distinguish between strategic and tactical alliances based on the timeframe of the alliance. Strategic alliances meet long-term purposes and are compatible with a company's long-term business plan. Conversely, tactical alliances are short-term in nature to meet immediate needs or fulfill a limited purpose. They note that these tactical alliances can be precursors to more rewarding strategic alliances in the future. However, Inkpen and Ross caution against giving too much credence to alliance descriptors such as "strategic." They say, "calling an alliance strategic provides an opportunity for alliance proponents to ignore economic/financial variables."⁵⁴

2.4.2 Horizontal vs. Vertical Alliances

Sillars and Kangari studied Japanese construction alliances in 1997.⁵⁵ They defined vertical alliances as relationships between companies that provide complementary services and horizontal alliances as relationships between companies that

compete. The study findings show that the Japanese contractors preferred horizontal alliances because they could see their value in competing in the global construction market to obtain new work. Little value was perceived from forming alliances with Owners or subcontractors. There was no direct mention of forming alliances with suppliers in this report.

2.4.3 Alliance Models

Several articles contained step-by-step models to identify and describe the key phases involved in creating, maintaining, and even dissolving alliances. A comparison of these various models can be found in Figure 2-3.

2.5 Alliance Red Flags

Grikscheit and Cag noted two recent business news stories that provide some lessons learned for future alliances.⁵⁶ The first was the dot com bust and subsequent stock market plunge in April 2001. They generalized that during the dot com boom cycle, the quantity of alliances, instead of the quality, became the key metric. They noted that the rapid pace of technological change created conflict with the focus on long-term results. They concluded that, "internet speed alliances proved to have internet speed lifecycles."⁵⁷ The second business news story involved the collapse of Enron due to an accounting scandal involving several off-book partnerships in November 2001. They suggest that future alliances will need to increase their diligence on ensuring the accounting and legal compliance matters of potential partners.

Phase Name	1	2	3	4	5
Alliance life-cycle stages ⁵⁸ ("Life & Death")	Birth (negotiation and formation)	Mid-life (Implementation & operation)	Death (Dissolution)		
Alliance Phases ⁵⁹ ("Marriage")	Courtship	Engagement	Housekeeping	Overcoming Differences	Old Marrieds
Alliance Formulation Model ⁶⁰	Identify	Evaluate	Negotiate	Implement	
Alliance Life Cycle ⁶¹	Alliance Business Case	Partner Assessment and Selection	Alliance Negotiation and Governance	Alliance Management	
Alliance Flow Chart ⁶²	Define the Alliance	Develop Goals & Mission	Identify Challenges & Obstacles	Define Criteria, Cost & Schedules	Identify Responsibilities
General Alliance Development Model ⁶³	Need Awareness	Search	Selection/Decision	Implementation/ Administration	Assessment: Sustain, Modify, Terminate

Figure 2-3 Comparison of Alliance Models

Kanter highlights under her “housekeeping” role that the transfer of alliances from formation to execution will involve more people in the alliance, many of whom were not involved in its creation. She suggests four reasons why this broader involvement of more employees can threaten the commitments formed in the alliance: First, new players in other positions may not experience the same personal bonds that the alliance creators did. Second, new players may be unaware of the larger vision of the alliance or be constrained by company or country cultural differences. Third, the alliance is not the primary responsibility of these new players and thus their performance evaluation is based on other factors. Finally, new players may oppose the alliance and work to undermine it.⁶⁴

Inkpen and Ross researched the issue of when alliances should be terminated. They identified seven characteristics that make alliances susceptible to persistence that results in companies sticking with alliances in the face of negative performance. The characteristics include:

- Difficulty in walking away from sunk cost associated with alliance creation.
- Pressure to match the competition that is forming alliances.
- Flying blind because alliance performance is difficult to measure.
- Senior managers’ involvement can become a liability when their ego and political capital gets tied to the alliance.
- Alliances are viewed as the answer to globalization.
- Belief that your partner will be able to fix the problem because you don’t have a true assessment of their capabilities.

- Closing alliances can be just as arduous as creating them.⁶⁵

2.6 Alliances in Engineering and Construction

The CAPS Research “Report of Cross-Industry Standard Benchmarks” shows that the Engineering/Construction industry does not effectively use strategic alliances relative to a broad range of 25 other industries averages.⁶⁶ This data set was modified to remove government agencies that typically have less flexible contracting options than the private sector as well as industries that had no reported use of alliances. The revised data set still consists of 15 industries covering a broad range of businesses with many sharing characteristics similar to large capital projects. The modified data reveals that:

- The Engineering/Construction industry spends a much higher percentage than the 15-industry average on purchases as a percentage of sales (Figure 2-4).
- The Engineering/Construction industry is near the bottom in terms of using alliances as measured by a percentage of purchase spend using alliances.
Shipbuilding provides an interesting benchmark of another industry with a high purchase spend relative to sales but with an above average use of alliances (Figure 2-5).
- There are many potential candidates for alliances in Engineering/Construction based on the large percentage of active suppliers that account for 80 percent of the purchase spend (Figure 2-6).

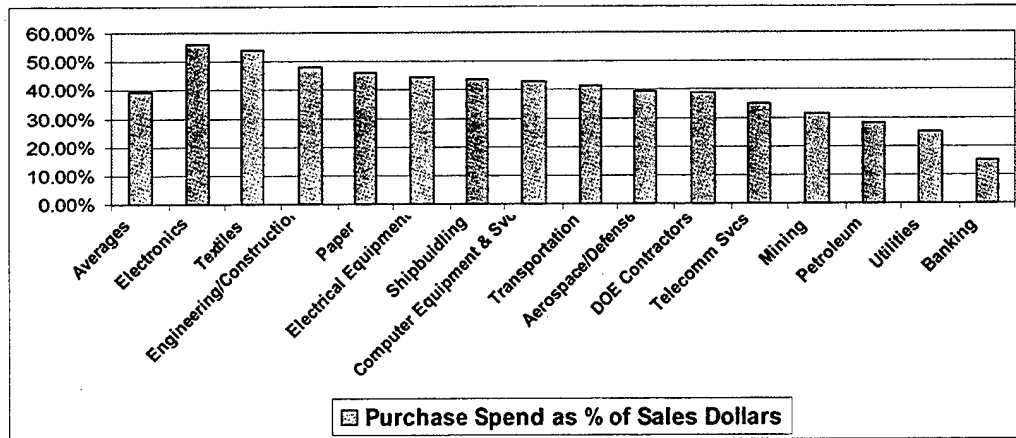


Figure 2-4 CAPS Research Industry Data by Sales

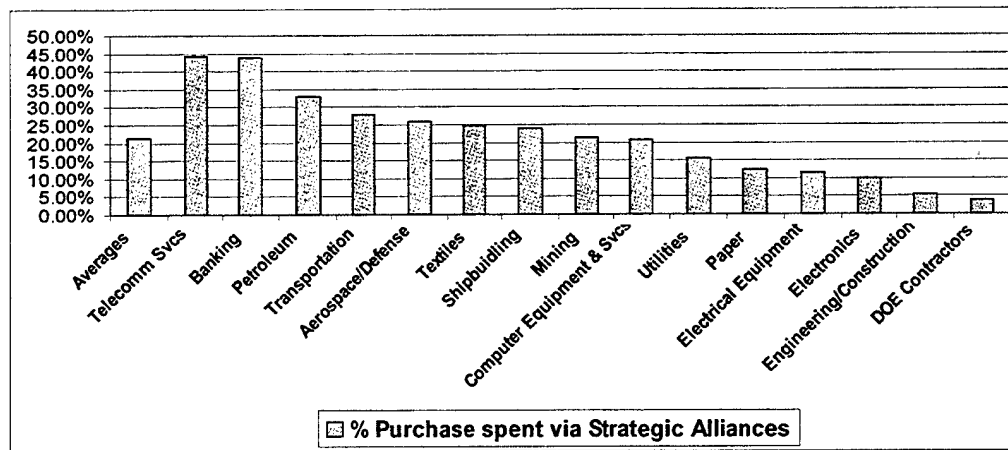


Figure 2-5 CAPS Research Data by Alliances

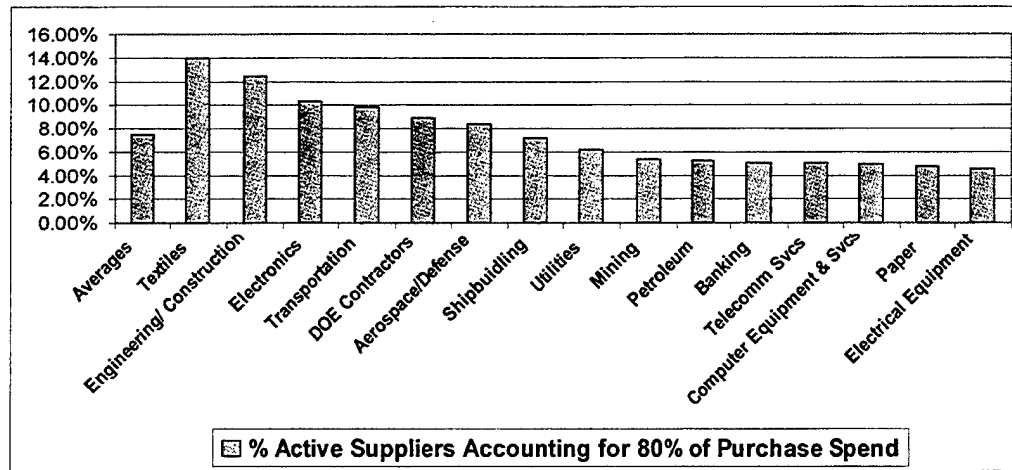


Figure 2-6 CAPS Research Data by Major Suppliers

2.7 Alliance Examples in Capital Projects

The following examples of publicly available information about Owner led alliances are provided as real-world case studies. The Sasol examples are very interesting because you can see how the strategy to be a global leader in gas-to-liquids (GTL) technology is the driving force behind their alliances that could justifiably be labeled as “strategic.”

2.7.1 Chevron-Texaco/Solar Turbines Alliance

This alliance was announced in January 2003 and involves an Owner, Texaco-Chevron and a major equipment supplier, Solar Turbines, that manufactures industrial gas turbines and compressors. The agreement is for five years, and Solar expects to supply more than \$50 million annually in equipment.⁶⁷

2.7.2 BP Andrew Field

This North Sea oilfield was believed to be economically unviable. BP formed a multi-team alliance with suppliers and EPC contractors. Financial rewards were tied to the final project cost. The project came in 22% under the target price and six months ahead of schedule. "The Andrew Alliance consisted of BP Amoco, Brown & Root, Santa Fe, Saipem, Highlands Fabricators, Allseas, Emtunga and Trafalgar House. Production began in 1996 and field life is expected to be around 17 years."⁶⁸

2.7.3 Sasol

Sasol, a South African energy company, is striving to be a global leader in the GTL technology to convert natural gas into a cleaner burning, synthetic diesel fuel. Since 2000, they have formed three alliance type agreements to enhance their competitive advantage in this technology. In October 2000, they formed a 50-50 joint venture with Chevron-Texaco to pursue commercial applications of GTL. Their plan is to execute three to four projects over the next 10 years at an estimated cost of \$5 billion. The second alliance involves a manufacturer, Engelhard, that produces a new cobalt catalyst, superior to the standard iron-based catalyst, to use in the GTL reactor process. The two companies recently opened a new manufacturing facility in the Netherlands in June 2002 to produce the cobalt catalyst exclusively for Sasol. Jan Fourie, Sasol's executive director for corporate technology, engineering, and environmental portfolios stated that,

"Our decision to partner with Engelhard reflects our willingness to form alliances with select international technology leaders in order to continuously advance and commercialise our competitive GTL technology in gas-rich regions."⁶⁹

The third Sasol alliance with a major equipment supplier for capital projects is most germane to this study.

Sasol/Nissho Iwai - IHI Alliance: This alliance was announced in April 2002 and involves an Owner, Sasol, and a major equipment supplier partnership consisting of the manufacturer, Ishikawajim Heavy Industries (IHI) and Nissho Iwai, a Japanese trading company or sogo shosha. The agreement is for the design, fabrication and supply of reactor vessels that are a major equipment component of the GTL process. Sasol has two GTL plants underway that cost \$1.2 billion and \$850 million. A typical GTL plant requires two reactors. It is estimated that this alliance could supply 14 to 20 reactors with an estimated value of \$200 million. Additional details concerning policies and process were found in a press release:

"John Marriott, Sasol's general manager responsible for technology, comments: "Optimising both production economics and technology partnerships have long been critical business objectives for Sasol. We also need to maximise our project management and procurement productivity, develop mutually beneficial technological and engineering partnerships, and endeavour to reduce the capital and operating costs of our international joint-venture GTL plants.

"It is primarily for these reasons that we opted to form a reactor procurement alliance with IHI and Nissho Iwai, a consortium that was selected by Sasol Technology from 15 potential suppliers in Japan, Korea, Europe and America. The entire selection process was undertaken after several months of in-depth exploratory discussions and comprehensive site visits."

Marriott adds: "The principles of the alliance are strict. The entire relationship between Sasol and IHI with Nissho Iwai will be based on a great deal of trust, transparency and mutual support. The overarching goal of the alliance is to create and maintain maximum synergy to benefit both parties."

Hisomu Nagai, Nissho Iwai's general manager responsible for gas-to-liquids projects, has worked closely with Sasol for the last 30 years." ⁷⁰

3 Research Plan

The impetus for this project, to study engineered equipment supplier integration for capital projects, was driven by discussions with key partner companies in the Supply Chain Resource Consortium (SCRC), a university and industry partnership that studies supply chain management issues at North Carolina State University. Bechtel Corporation, a global EPC contractor currently ranked sixth in the 2002 ENR Top 225 Global Contractors, is an industry participant in the SCRC and identified this topic as an issue for research.⁷¹ Several project scope and requirement meetings were held in August and September 2002 to establish objectives for the work.

3.1 Problem Statement

Procurement of engineered equipment has traditionally been done using the lowest technically qualified bid. Supplier selection decisions are made from which there is lost opportunity due to failures by the buying organizations to capitalize on and integrate the suppliers' detailed knowledge about the engineered equipment they produce.

3.2 Objectives

To develop new tools to improve supplier integration for engineered equipment in capital projects, the following study objectives were identified:

- Determine the state of practice and state of the art methods being used to integrate major (engineered) equipment suppliers in other industries involved in capital projects type work.

- Survey industry participants including Owners, EPC contractors, and Suppliers primarily involved in energy sector capital projects.
- Analyze the survey data to identify trends and reoccurring common themes.
- Develop and assess a model to describe the results of the survey that could be utilized to improve supplier integration for engineered equipment.

3.3 Methodology

A state-of-the-art literature review was conducted. Most information was found using:

- other research organizations, e.g. Construction Industry Institute (CII) and CAPS Research.
- recommendations from industry experts interviewed for this research including proceedings from conferences.
- scholarly databases (e.g. ABI Inform, Business Source Elite, Lexis-Nexis, available on-line through the university library) for keyword searches (e.g. alliances, collaboration, etc.).
- keyword searches using internet search engines such as Google.
- information acquired from other graduate coursework that could be immediately applied to this research.

It was determined that an appropriate methodology involved collecting a combination of quantitative and qualitative data. Quantitative data was collected using the questionnaire found in Appendix A. The questionnaire has four main sections that

focus on: Opportunity, Barriers, Contracting, and Metrics related to supplier integration. A draft version of the questionnaire was piloted with key contacts at Bechtel prior to dissemination. Qualitative data was captured through personal interviews with industry experts either through personal or phone conversations. The interviews were semi-structured and relied on a set of standard questions, found in Appendix B, as a starting point for discussion. The interview questions focused on the organization and its:

- Current Process: Respondents were asked to describe how major equipment items are procured today and to discuss any alliance agreements.
- Reengineering the Process: Respondents were asked their opinions on identifying ways to improve supplier integration.
- Future Strategies: This was an open-ended question that looked for new ideas to improve supplier integration for major equipment items in capital projects.

The interview length ranged from 30 minutes to two hours. The majority of the interviews lasted one hour.

The process used to collect the data proceeded as follows. The prospective participant was sent an email package including an introduction letter from an academic advisor and the researcher (Appendix C). The letters identified the purpose of the study and asked the recipient to consider participating in the study. The participants were asked to complete the questionnaire prior to the interview. The researcher interviewed 50 percent of the participating companies in person during a data-gathering trip to Houston, Texas from October 14 – 18, 2002. The remaining companies participated in telephone

interviews between November 2002 and March 2003. No major differences were detected in the quality of the interviews between personal and phone communication.

Following the initial interviews in Houston, it became apparent that a key element explaining the variance in supplier integration strategies was the nature of an alliance agreement used to manage the initiative. A mid-course review was held with managers from Bechtel to focus the research on critical issues surrounding alliances: development, measurement, and management. Revised research questions focused on:

- Development: How do you justify or make the business case for alliance agreements?
- Measurement: What metrics do you use to measure alliance performance?
- Management: How do you keep alliance agreements from developing complacency in terms of cost, technology, and other factors? How do you exit an alliance agreement if it does not remain competitive?

Interview Question 1.2 (Appendix B) that already focused on alliances was enhanced with these additional focus questions. The Interview Question instrument was not amended with these focus questions. Instead, future participants were highlighted to the emphasis concerning alliances in Question 1.2 (Appendix B) in the text of the email transmitting the interview questions. The final 50 percent of the companies interviewed were encouraged to focus on alliances during the interview.

3.4 Participants

Twenty-one companies were invited to participate in this research; of these, 16 companies agreed to participate. The study involved 42 representatives from these companies. Participants were primarily identified by Bechtel managers who were asked to identify key companies representing Owners, Suppliers, and EPC contractors that were recognized in the industry for best practices in supplier integration management (see Glossary for Delphi forecasting method). Using existing Bechtel relationship contracts proved to be very effective in identifying 63 percent of the participants. Thirty-one percent of the respondents were identified by the researcher either through SCRC contacts or literature searches of leading companies currently engaged in supplier integration projects. These companies were also selected to provide additional insights in the electric power industry and include a broader international perspective. Forty-four percent of the companies were non-U.S. based with four based in Europe and three in Asia. For foreign companies, U.S. based offices were interviewed to improve communications. Six percent of the respondents were selected based on recommendations from companies we interviewed in the first set of interviews.

The 16 companies can be grouped into four categories: Owners, EPC contractors, Suppliers, or Others. To maintain confidentiality, the companies will be referred to in the report by a sequentially assigned number based on the company's category. EPC contractors include 20 participants from six EPC companies referred to as Companies 1, 2, 3, 4, 5, and 6 in the report. While all six companies operate globally, three are based in the U.S., two in Asia, and one in Europe. Owners consist of operators in the petroleum

and electric energy sectors. This category includes eight participants from three global companies referred to as Companies 7, 8, and 9 in the report. Two companies are U.S. based while the third is based in Europe. Suppliers include six participants from four global suppliers. Three suppliers are U.S. based and one is from Europe. The supplier companies are referred to as Companies 10, 11, 12, and 13 in the report. Three companies are categorized as "Others" because they are either not involved in the energy sector or can not be characterized as an Owner, EPC contractor, or Supplier. These three companies, yielding four participants, are otherwise involved in capital projects and were selected to broaden the perspective of this research. The "Others" include one company each from the U.S., Europe, and Asia. The "Others" are referred to as Company 14, 15, and 16 in the report.

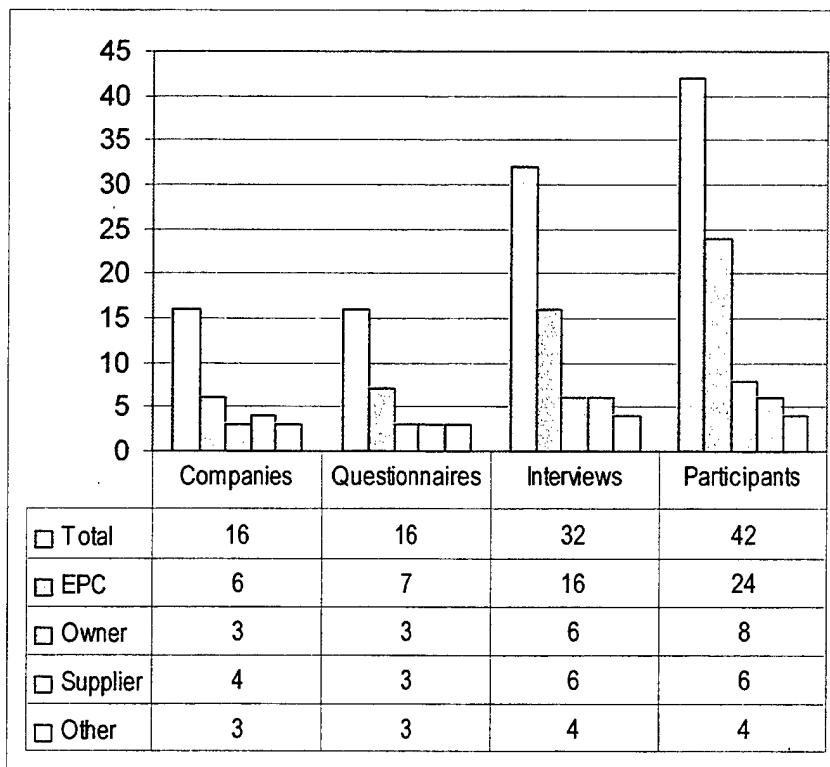
3.5 Data Analysis

A total of 16 questionnaires were completed. Four companies did not complete the questionnaire. Three companies had multiple, different respondents complete the questionnaire. The largest number of questionnaires returned by a single company was three. Interviews were accomplished with 32 respondents representing fifteen of the identified companies. A more detailed analysis of the statistics concerning the companies, questionnaire, interviews, and number of participants can be found in Table 3-1.

Notes from the interviews were formatted into standardized reports that could be shared with the faculty advisors. The reports generally followed the outline of the interview questions, Appendix B, but also included additional comments gathered during

the interview. All of the reports were analyzed along with the questionnaire to develop broad categories that became the basis for the model described in Section 4. The category codes included: CM – Company Management issues; BD – Business Development issues that later became the Business Case; AF – Alliance Framework issues; M/M – alliance Measurement and Metric issues; and AM – Alliance Management issues.

Table 3-1 Survey Statistics



4 Capital Projects Supplier Alliance Model (CaPSAM)

The framework of this alliance model follows a path of decision points that a buying enterprise will encounter when developing and managing alliances with suppliers for large-scale capital projects. The model is similar to the structure of the various alliance models discussed in the literature review, Section 2.2.5 Alliance Models, in that it follows a linear sequence of decisions over the life cycle of the alliance. The decision maker starts on the left with broad-based business decisions and moves to the right with increasing specificity about detailed contractual arrangements moving towards the management and sustainment of the alliance. The first decision, Company Self Assessment, is an internal assessment of the company's own management structure to operate in alliance relationships. Alliances require collaboration between two or more companies that necessitates a different mindset from the low bid equals best value traditional line of thinking.

The second step is developing the Business Case justifying the alliance. For this study, the focus was on Owners or EPC contractors, primarily in the energy sector, forming alliance agreements with Suppliers for major equipment items that are characterized as having high costs and long lead times to procure. The business case should answer a broad range of questions such as:

- What major piece of equipment should the alliance pursue?
- Are alliance relationships a better way to conduct business?
- What opportunities and barriers exist?

- Is there a business case that an alliance agreement will provide a competitive advantage in the market that will lead to above normal profits for all participants?
- What do the prospective participants bring to the table?

The third step involves Supply Base Management and involves determining the number of suppliers and making the supplier selection. The fourth step is establishing the Alliance Framework that sets the working arrangement for the alliance involving contract details and cost sharing arrangements. The final step is Alliance Management and Metrics which is focused on establishing metrics that can be used to manage, maintain, and improve the performance of the alliance agreement and, as necessary, dissolve the relationship. A key focus in Alliance Management and Metrics is countering complacency that can sometimes occur in long-term alliance agreements.



Figure 4-1 CaPSAM

4.1 Company Self Assessment

“Strategic sourcing is counter cultural. People do not understand it yet. It goes against all their previous learning and experience in procuring/purchasing.”

Respondent from Company 4

Before a company proceeds with developing an alliance agreement, they should ensure that their company is organized to foster an alliance relationship.

While the following comments from Company 8 were directed to concerns raised by the client or end-user, they could also equally apply to internal company customers.

“The most important thing is the education of the client or end-user. It is necessary for them to buy into the use of an alliance. They must feel comfortable with its use and trust that it is in their best interest. There is a natural feeling at this stage that someone is going to profit in an unethical way from the use of such an agreement. For this reason a very heavy sell job is required. As in the alliance by (Company 8), there must be shown that there is some system of cost savings sharing which will benefit all. It must be shown that there is a constant review that will make changes to keep or improve the competitiveness established by the alliance. There must be established some means of showing the client that changes and costs resulting are fair and not a means of gaining wealth. In all the client must be able to see why this is the best route and how he will be protected from pitfalls during the process. At the same time the supplier must feel assured that his data/information will not be exposed to competition.”

Companies need to ensure that their internal customers are fully debriefed and understand the concept of alliance agreements and will utilize them if they are established. This appeared to be a major issue in EPC companies that need to align the value perspectives of the key internal customers including project management, procurement, and engineering. Also, input from field representatives during construction or operations needs to be solicited to assess the value of the alliance. Procurement should strongly support alliances since they have access to the data, understand the benefits, and have most likely contributed to the development of the business case for the alliance. A respondent from Engineering at Company 5 measured alliance value in terms of reduced direct engineering that the company had to provide because the alliance supplier

accomplished certain specialized engineering tasks. There was good awareness that the engineering services provided by the supplier was very detailed, directly involved their product, and that the supplier had greater design/technology expertise than the EPC contractor. The same respondent from Company 5 also mentioned that equipment inspections by the EPC can be minimized and possibly eliminated or made optional because the alliance supplier's processes are validated as part of the alliance agreement and that a high degree of trust exist between the parties. A Supplier, Company 10, noted that reduced inspections improve their operations because it limits starts and stops in the manufacturing process.

In many cases, there appears to be conflict over the ability of Project Managers to procure equipment items covered by an alliance agreement using other procurement methods. This obviously acts as a "no-confidence" vote in the alliance agreement and conveys the perception that Project Management believes they can achieve a better deal than the existing alliance agreement for their project. This type of non-compliance is a major reason for the breakdown of alliance agreements in the EPC industry, as alliance suppliers lose faith in the ability of the EPC to fulfill their alliance obligations. Before an alliance agreement is established, all internal customer concerns should be communicated and resolved. Senior management should give strong support to the alliance agreement by mandating their use. This policy could have some flexibility to allow Project Managers who believe that the alliance agreement is not preferable for their project to develop an alternative procurement strategy, but this approach should be approved by senior management. However, a representative from Company 9 cautioned that if a

company were to bid their alliance agreement against the market, the alliance supplier's competitor might take a "cheap shot" to get the work at zero profit or even a loss to obtain the work or perhaps to undermine the strength of the alliance. This will most likely lead to problems in the project execution. This respondent estimated that at least 85 percent of the time the alliance agreement will beat the competitive market price. They did not believe that it was worth the gamble to save maybe an extra two percent on the price of major equipment while losing critical time with a bid-evaluate-award process rather than using the alliance agreement. Their advice was to place the order in keeping with the strategic intent of the alliance agreement and keeping the project on schedule.

Company 6 felt strongly that Procurement should report directly to Engineering in order to manage alliance agreements. They viewed procurement as an engineering, not buying, function. They also felt that Engineering and Project Management do not understand vendor relationships and squeeze Suppliers on price and time instead of treating them fairly. Conversely, a Project Manager from Company 5 felt that alliance agreements cause Procurement to lose their internal customer perspective because they get focused on the alliance relationship.

4.1.1 Teams

Company 16 uses Integrated Process Teams (IPT) that included staff from engineering and procurement to develop projects using a two-part design process. The prototype or first stage design, is selected based on the "best" design and not the lowest cost. The second stage of their design process is determined using "low bid" as the primary selection criteria.

Company 5 has successfully used the team concept on some projects but has not institutionalized the process as a best practice. One project created teams from engineering and procurement that also included suppliers. The teams were given control over their budgets in terms of the equipment plus their engineering manhours. Including the suppliers in these teams helped in establishing design parameters, driven mainly by the equipment, earlier in the design process and minimized redesign work later when the supplier is typically involved.

A representative from Company 8 noted, "While increased supplier integration may pay dividends on a given piece of equipment, the manpower necessary to work the issues may be in scarce supply." As we will discuss in the Alliance Framework section, developing alliances takes time and may require a dedicated alliance team to manage this function if the number of alliances grow.

4.1.2 Alliance Management Function

Dyer, et al, suggests that the most successful alliances occur in companies with dedicated alliance management functions. Their study included 200 companies involved in 1,572 alliances. They found that, "enterprises with a dedicated alliance function achieved a 25% higher long-term success rate with their alliances than those without such a function."⁷² The article highlighted some best practices, such as Hewlett Packard's (HP) development of an alliance manual (300 pages) that includes tools and templates for making alliance decisions. HP has also fostered alliance training and sharing of knowledge by developing a 3 hour short course as well as two day alliance management course.

Company 8 has established two positions for their strategic purchasing units at the corporate level. The “category manager” is responsible for developing cost savings measures across the business units for the product line they are managing. Their counterpart is called a “strategic relationship manager” who serves as the key contact for the supplier. Their goal is to develop value-added benefits for their company and not clear cost cutting targets such as those for which the category manager is responsible for. This strategic relationship manager role is similar to the ombudsman role; “A man who investigates complaints and mediates fair settlements, especially between aggrieved parties such as consumers or students and an institution or organization.”⁷³ Monczka, et al describe the role of the supplier ombudsman at Honda of America as the person,

“... who deal(s) with the soft side of the business – primarily the human resource issues that are not associate(d) with cost, quality or delivery. Because an ombudsman is not involved in contract negotiations, suppliers are often much more willing to talk with the ombudsman.”⁷⁴

4.2 Business Case

“Major projects may not allow the time necessary to cultivate supplier integration.”

Respondent from Company 8

As this introductory quote suggests, waiting until a major project is underway is probably too late to start thinking about integrating a supplier’s knowledge into the capital projects acquisition process. As discussed in the literature review, the main thrust of the PEpC study was that procurement of major equipment items need to start prior to detailed engineering to incorporate the supplier’s knowledge in the process. The PEpC study focused on the process but did not recommend a method to accomplish this

objective. Alliances could provide a mechanism for implementing the PEP process of integrating suppliers of major equipment earlier, and more meaningfully, in the capital projects acquisition process. This section will discuss identification of major equipment candidates for alliance agreements as well as the possible benefits and barriers to implementing these alliance agreements.

4.2.1 Major Equipment Identification

The goal of the Business Case decision is to select the major equipment item(s) for an alliance agreement. A recent presentation and paper at a National Petrochemical and Refiners Association (NPRA) conference provides an excellent guide to strategic sourcing using cross functional teams that can be a guide for identifying major equipment.⁷⁵ Monczka, et al state that,

“The focus of strategic sourcing management involves managing, developing, and integrating with supplier capabilities to achieve a competitive advantage. Advantages may be gained through cost reduction, technology development, quality improvement, cycle time reduction, and improved delivery capabilities to meet customer requirements.”⁷⁶

Some key outputs from the NPRA strategic sourcing approach include:

- Understanding your current spend segmentation to determine what you buy, how you buy it, and who you buy it from.
- Understanding the “Total Cost of Ownership” (TCO) for the equipment. TCO includes the product cost + acquisition cost + life cycle cost.
- Segmenting your equipment based on your maneuverability (power to influence) in the market and the relative amount that the purchasing cost represents the TCO.

The categories include: reduce purchase price, restructure, re-engineer, and jointly improve processes. See Figure 4-2.

Alliances and joint ventures are recommended for equipment items that are segmented as “Restructure.” Hill notes that these tactics,

“may take more time and patience to implement ... (but they) can often lead to substantial procurement advantages over other competitors who have not taken the time to explore and build these new types of relationships.”⁷⁷

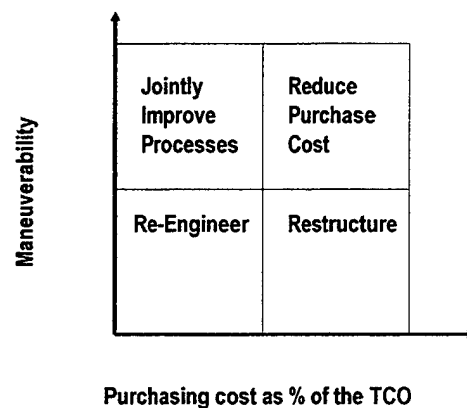


Figure 4-2 Sourcing Tactics⁷⁸

Company 8 noted that, “while the number of single source strategic equipment contracts is relatively small, the dollar value is quite high.” In petroleum and electric power generation plants, a relatively small number of major equipment items account for a large portion of the project equipment spend (budget). One major equipment category that meets this definition is compressors and gas turbine mechanical drivers. A representative from Company 5 estimated that this category of equipment represents

approximately 10 percent of a \$1 billion liquefied natural gas project that converts natural gas to a liquid state for transportation. While this study did not specifically focus on building a business case for compressors, two compressor suppliers were interviewed in order to gain their perspectives on this issue. Also, the compressor example provides some real reference points to ground this study from an abstract model.

The PEpC study also identified some characteristics of major equipment items that would benefit from supplier involvement:

- “System performance depends on a technology that is a core competency of the supplier.
- System performance characteristics vary significantly from supplier to supplier.
- Delivery configurations vary substantially and there is potential for change in configuration.
- The system and its associated components are highly engineered and closely integrated.
- The system or process is complex, and there is substantial potential for simplification or standardization.
- Knowledge of system engineering, configuration, and integration is a supplier core competency.
- Design interfaces between the system and other portions of the project are complex, variable, and subject to interpretation.
- System sizing, configuration, and selection are critical to the principal engineering activities.
- Lead times for system selection, design, and delivery are long with strong dependencies in the overall project schedule.”⁷⁹

4.2.2 Potential Benefits

The questionnaire asked respondents to identify the benefits resulting from supplier integration of major equipment (Appendix A, Question 2.3). The responses indicate that cycle time reduction and quality improvements are the primary benefits of supplier integration. Ninety-four percent of the respondents asserted this even over cost

which had a 75% response rate. Outcomes of the personal interviews also support that *time savings and quality improvements from supplier integration were perceived to be of greater value than initial cost savings of the engineered equipment item.* The following comment from a representative with Company 8 reflects this idea:

"Early supplier integration may actually result in higher initial CAPEX (Capital Expense) costs; however, scope is better defined prior to project execution - thereby reducing mid-project change orders. Early integration also allows design/constructability reviews to take place early to enable scope/functionality optimization, schedule flexibility and/or production manufacturing slot optimization. All of these can lead to reduced manufacturing costs. Lastly, early supplier integration can result in improved field operability and/or maintenance of a piece of equipment; thereby reducing the overall Total Life Cycle cost."

The review of a generic EPC project timeline shows the importance of cycle time reduction for engineered equipment items. Figure 4-3 shows the overall EPC timeline with a breakout of the engineered equipment manufacturing schedule. It is very likely that the major equipment will become a critical path item on the overall capital projects schedule. A respondent from Company 8 noted that the normal competitive bid selection process can take from four to six months from initial inquiries through supplier selection. This respondent went on to describe the company's experience with a supplier alliance where representatives from the Owner, EPC contractor, and Supplier met for one week and accomplished the following: approved the engineered equipment items' specifications, agreed the final price for the equipment, and placed the order allowing a production slot to be reserved.

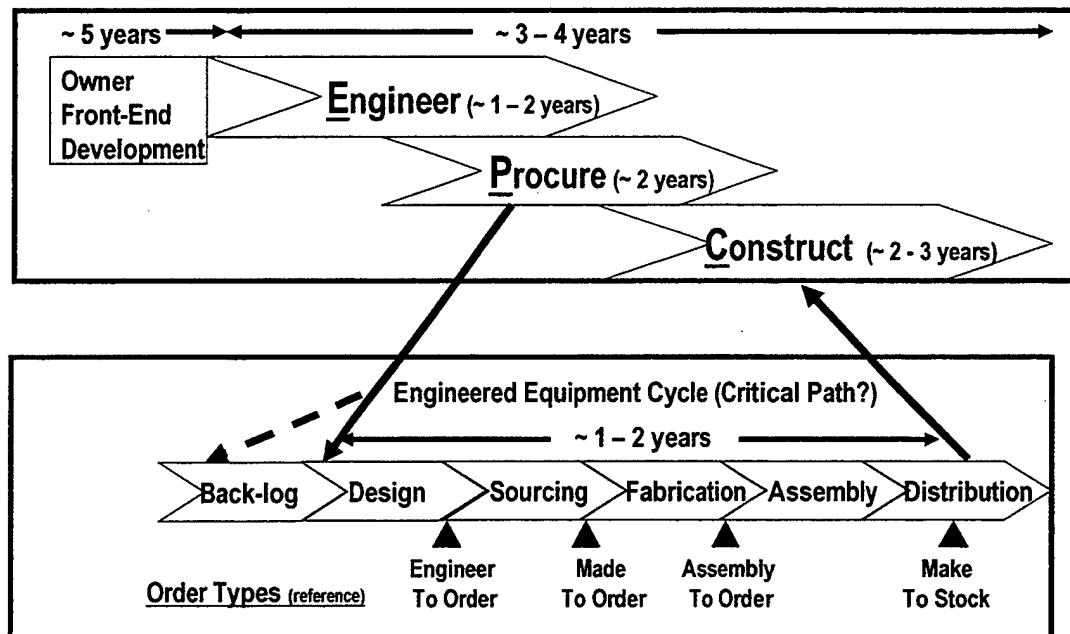


Figure 4-3 Capital Projects Timeline

Respondents were asked to select project phases that they believed improved supplier integration could either reduce and/or improve a projects schedule (Appendix A, Question 2.5). All of the listed phases received more than 50 percent selection each. Fabrication schedule and shop drawing design were the two phases most selected with each receiving 75 percent or more selected response, see Figure 4-4.

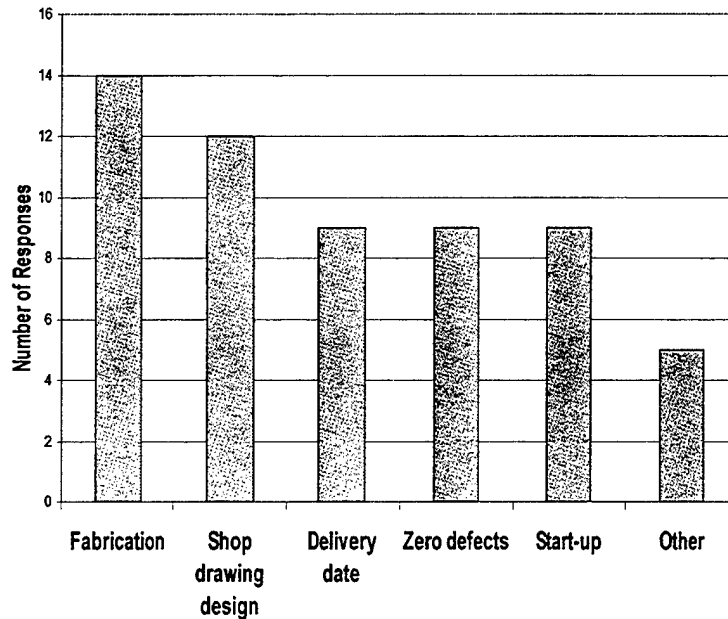


Figure 4-4 Project phases that supplier integration would improve

The questionnaire asked for a range of cost savings that could be achieved using supplier integration for major equipment (Appendix A, Question 2.4). The most selected range for initial price reduction was six to ten percent (Figure 4-5). This is consistent with results from a study conducted by CII which found that improved supplier involvement could produce four to eight percent cost savings of the traditional EPC process.⁸⁰ Respondents felt that lower cost savings in the range of one to five percent could be achieved in other project phases including installation, start-up, and warranty during the construction period. Some respondents provided additional comments that significant savings could be realized in engineering. Company 4 estimated that supplier

integration in the engineering phase could reduce the EPC's engineering time, saving 10 to 20 percent on the project. Company 5 noted that they would have to hire additional engineers to handle some of the detailed, equipment specific calculations that are now being completed by their alliance suppliers. Company 13, a Supplier, believed that their involvement could reduce engineering cost by as much as 40 percent. Cost savings in the engineering phase from supplier alliances appears to be a significant savings that needs further study.

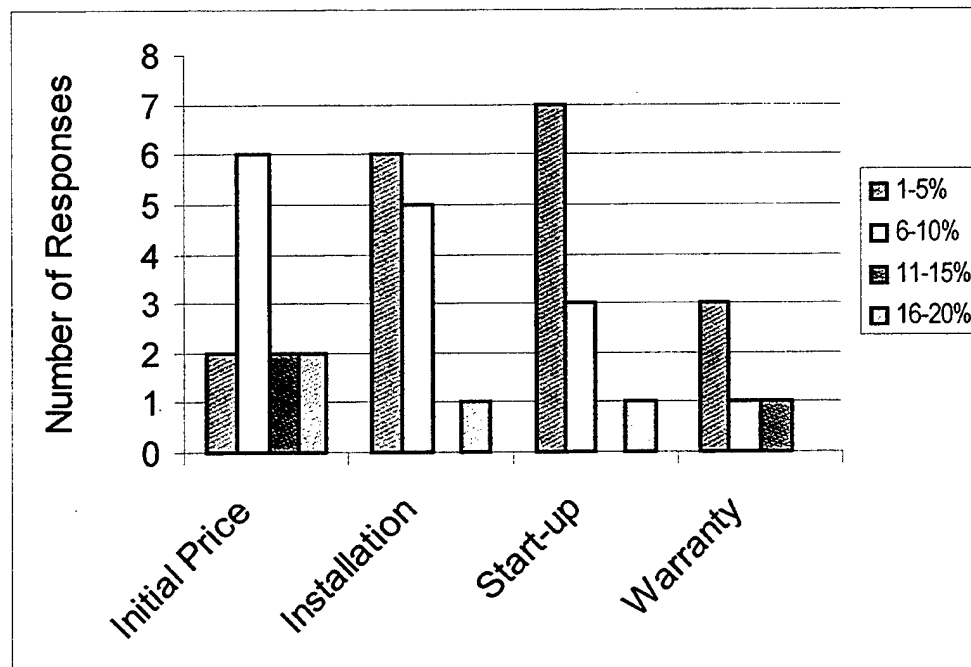


Figure 4-5 Supplier Integration Cost Savings

4.2.3 Possible Barriers

Conflicting goals and trust were the top two responses (based on a weighted score) from the questionnaire regarding barriers to improving supplier integration (Appendix A, Question 3.3). This question asked respondents to rank order their top three choices, out of a list seven possible choices plus a write-in space for others, for barriers to improving supplier integration. The answers were measured both in terms of the total number of responses plus a weighted scoring method. The weighted scoring method simply allocated more points in a reverse order based on the ranking. For example, a number one ranking would be scored as three points, etc. Reevaluating the questionnaire in hindsight, the number of possible choices should have been reduced or the respondents asked to rank order their top four choices to increase the possibility of an answer being selected from 38 to 50 percent. A ranking of the top five answers can be found in Figure 4-6.

Recognizing that conflicting goals is a key barrier to supplier integration adds more importance to the third step of the model, Alliance Framework, which addresses the importance of establishing alliance goals.

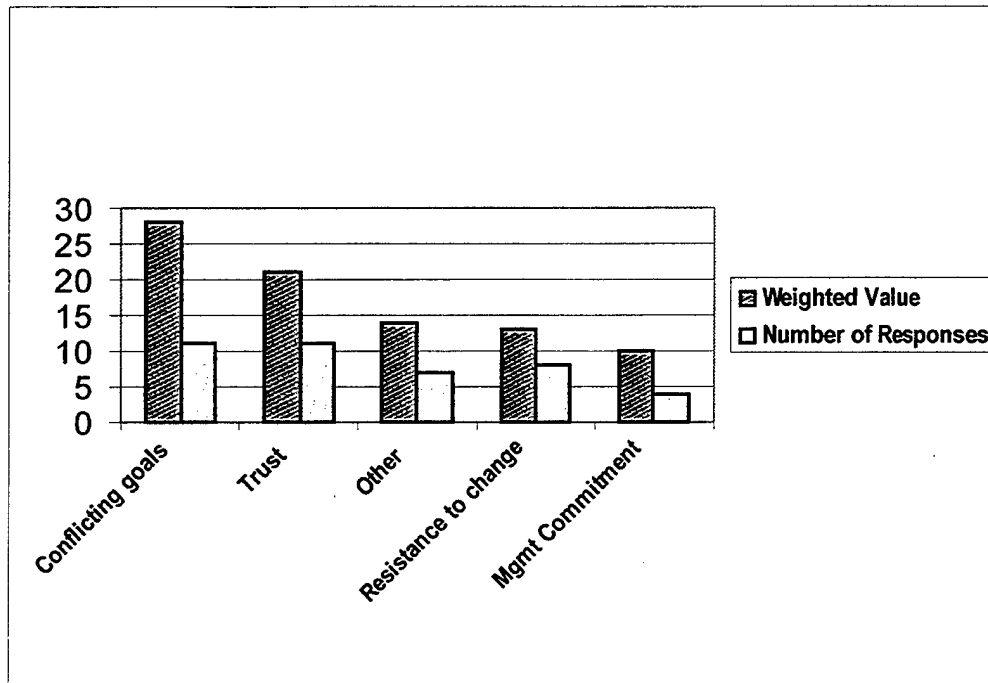


Figure 4-6 Barriers to Supplier Integration

There are numerous articles that discuss issues surrounding trust. Handfield and Nichols provide five rules of thumb for developing trusting relationships with partners in the supply chain that are relevant to this study:

- “Rule of Thumb 1: Follow through on your commitments, and act in a predictable manner.
- Rule of Thumb 2: Choose a supply chain partner with a documented record of experience in the technology. Also ensure that the partner is assigning competent, knowledgeable, and experienced people to managing the relationship.
- Rule of Thumb 3: In selecting the primary interface with your supply chain partner, choose an individual who has a high level of knowledge in the technology or function, good ‘people’ skills, and good ‘commonsense’ knowledge.

- Rule of Thumb 4: The perception of vulnerability needs to be carefully managed by supply partners through information sharing, which assures the other partner that its interests will be protected.
- Rule of Thumb 5: Show genuine responsiveness to your partner's needs and demand the same of your partner if necessary. Be willing to 'go out on a limb' if the situation requires it."⁸¹

A final interesting note from this question is the low response that the lack of financial incentives (cost sharing) is a barrier to supplier integration. Views generated from this study about cost sharing are further described in the Alliance Framework section.

4.2.4 Strength of Relationships

The respondents were asked to select one relationship where they believed collaboration has traditionally been the strongest in the industry (Appendix A, Question 2.2). The questionnaire showed that most respondents viewed the Owner-Supplier relationship as the strongest in the industry. The Owner-Contractor relationship was ranked second followed by the Contractor-Supplier relationship, see Figure 4-7.

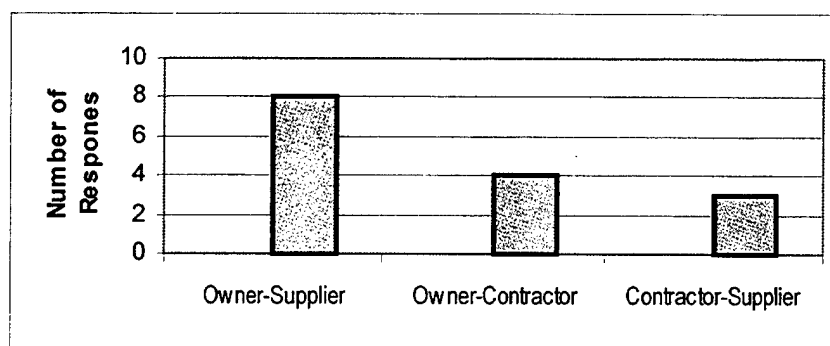


Figure 4-7 Strength of Relationships

A representative from Company 8 provided some insights into why Owner-Supplier alliances might be more beneficial:

"The owner has the incentive to spend the time and money necessary to collaborate with suppliers to optimize operability and the total life cycle cost of the given piece of equipment. General contractors working on some type of a fee or lump sum basis generally do not have the incentive (or in some case the operational knowledge) to collaborate on these "OPEX" (Operational Expense) issues, but rather are focused on "CAPEX" (Capital Expense) front-end costs."

A representative from Company 9 stated the issue in these terms: The Owner's money is being used to buy the major equipment and establishing alliance agreements with Suppliers enables them to receive the benefits. This person also felt that EPC contractors would better focus their efforts on their strengths in bulk material items where they can buy more effectively than Owners due to their leveraged volumes. An Owner representative from Company 8 provided a contrary view that it might be better for the EPC contractor to have the alliance agreement so that they could see the value in the alliance.

Several counter-arguments were offered from EPC companies suggesting why alliance agreements might be better suited between an EPC and Supplier. A representative from Company 4 noted that most Owner-Supplier alliance agreements are focused on operational issues with an emphasis on equipment operability and less focus on CAPEX (capital expense) cost. An important issue for these alliances is response time to repair or replace a major piece of equipment to resume operations. Company 4 felt that EPC alliance agreements could focus more on cost savings because capital projects are planned decisions that allow a company to determine in advance when a piece of

equipment will be needed. Company 6 noted that they offer their alliance agreements to the Owner at the start of the project so that they can compare the Owner's and EPC's alliance agreements for major equipment and select the best one for the project.

A representative from Company 12, a Supplier, suggested that the organization's reference time frame to the project impacts their view of alliance relationships. They highlighted that Suppliers are geared towards the Owners' longer term operations and maintenance considerations expressed with life cycle cost issues; whereas EPC contractors have shorter ties to the project from construction through the warranty period and are thus more focused on total installed cost. This respondent described a long term, 8-12 year, parts and service contract that they provide where the key measure is reliability of the equipment. The contract is structured with incentives for the supplier to exceed the baseline operations targets. A representative from Company 8 highlighted the importance of equipment reliability by saying that;

"The cost of (equipment) and its operating cost are absolutely insignificant in comparison to the revenue hit and deferred production that would result from the failure to the equipment."

Several Suppliers noted that it would be difficult, but not impossible, to have alliance agreements with EPC contractors. Company 11 currently only has alliance agreements with Owners and felt that they would be at a disadvantage to only have an alliance agreement with one EPC contractor. These companies believe that other EPC contractors would not quote their equipment under these conditions. They feel that if they had an alliance with one EPC contractor that this alliance should be available to any EPC contractor that wanted to participate in alliance agreements.

In this study, the "Owner" category represents the operating company; however, most projects involve ownership groups that may include multiple operating companies, host nation government agencies, and financing organizations. Out of this Owner partnership, there may be project host country or financing requirements that will bear on major equipment decisions that could override an alliance agreement. For example, national oil companies may require a certain percentage of local content or require the use of their preferred suppliers. Likewise, export credit agencies, such as the U.S. Export Import Bank, require a high percentage of U.S. content.

4.2.5 Economic Considerations

Difficulty in forecasting economic conditions was also mentioned as an alliance barrier. Respondents mentioned that during the up cycle, alliance agreements were advantageous to an EPC or Owner because one could get a good price and better schedules. However, during down cycles, the secondary market has much cheaper prices with the equipment already available for immediate delivery, although it might not meet one's exact specifications. A respondent from Company 5 noted that to get the lowest prices, one must commit to long term spend through good and bad years. Summarized, the alliance agreement tends to be more advantageous to the buyer during market conditions favoring the seller and more advantageous to the seller in a buyer's market.

4.3 Supply Base Management

"Not all companies by the nature of their structure/management can be considered candidates for such agreements. Not all companies wish to enter into such an agreement with your company. I believe that a

company or contractor must look at their major suppliers for equipment and determine which one will best help them through use of an alliance. It must then be determined that both the time and cost of producing such an alliance will be invested and that the organization will completely support it. The supplier must also be able to see the benefits that will flow to him from such an arrangement. Be ready to hold hands and trust.”

Respondent from Company 8

Supply base management involves the, “selection, development and maintenance of supply.”⁸² Trends in supply base management include:

- Reduction in the size of the supply base
- Increased use of long-term contracting
- Increased purchase volume consolidation
- Increased efforts to develop supplier performance capabilities⁸³

4.3.1 Number of Suppliers in a Major Equipment Alliance

A respondent from Company 8 believed that one could only establish an alliance with one supplier for each type of major equipment.

“It is impossible to set-up alliance with all suppliers of a certain type of major equipment. Trust will rapidly go out the window if a supplier determines that you are negotiating with a competitor. The risk of (exposure) of confidential information is too great. Therefore, the number of alliances that can be created is limited.”

Many non-supplier companies were concerned about “leaving money on the table” and believed that having two suppliers would be beneficial to maintain competition. A different respondent from Company 8 felt that single source alliance relationships may not be healthy. Company 7 generally associates alliances with sole source decisions. Their partners are typically selected on a competitive basis comparing

their total cost and other factors that are included in their package. Monczka, et al, addresses the issue of the absence of competition by noting,

“that careful supplier selection and the development of contracts that address any risks should prevent reliance on suppliers who try to take advantage of a single-source situation.”⁸⁴

4.3.2 Exclusive Agreements

Several respondents including both Owners, Company 9, and Suppliers, Companies 11 and 12, noted that it would be difficult to establish an exclusive use alliance agreement with one Supplier because the Owner role is usually made up of a group of organizations that might include other companies, host nation governments, and finance organizations that have criteria that could override an alliance agreement. This situation is understood in the industry. However, the Suppliers felt that in the major engineered equipment category that they had established strengths in certain equipment operational ranges. They would negatively view an alliance with a competitor that included a category of equipment where they were the unofficial market leader.

4.3.3 Selection

Company 11, a Supplier, stated that they do not actively market alliances but rather require the customer to initiate the discussion to establish an alliance. Their philosophy is that you need partners who are open to the idea that you can transact business differently than low bid. They noted that most companies that decide to form an alliance start the selection process with a questionnaire. The first question asks if you are interested in an alliance. This is followed by several questions that help determine the supplier's quality and financial condition. Most selections don't focus on price at this

early stage. The initial questionnaire can be followed-up with another questionnaire, site visits, negotiations, etc. All of these factors contribute to the length of time that it takes to establish an alliance. Most respondents said that it could take up to one year to establish an alliance agreement.

This study did not focus on the detailed mechanics of selecting alliance partners. However, Company 5 and 6 did note that they require their suppliers to meet the applicable International Organization for Standardization (ISO) certifications for quality management practices. Company 6 felt that this makes their supplier's quality control and cycle times much stricter. Company 5 also evaluates the supply chain of their suppliers by using the same selection criteria to evaluate the first tier sub-suppliers of major equipment suppliers. It should be noted that other companies in this study may also be engaging in these or similar activities, but the research tools did not specifically address this information.

Monczka, et al, note that the primary criteria to rate suppliers include the factors of cost, quality, and delivery (time). They recommend that the applicable selection factors are weighted to establish a selection process matrix.⁸⁵ A list of possible selection criteria from different sources is included for reference in Table 4-1.

Table 4-1 Alliance Partner Selection Criterias

Purchasing & Supply Chain ⁸⁷	Project Alliance Selection ⁸⁷	CII/PEPC Supplier Evaluation Matrix ⁸⁸
Supplier management capability	Demonstrated ability to complete the full scope of work	Base Bid Offering (Weighting - 15%)
Overall personnel capabilities	Demonstrated ability to minimize project capital and operating costs without sacrificing quality.	Reliability (Weighting - 20%)
Cost structure	Demonstrated ability to achieve outstanding quality results.	Price (Weighting - 10%)
Total quality performance, systems, and philosophy	Demonstrated ability to add value and bring innovation to the project.	Project Execution (Weighting - 10%)
Process and technological capability, including the supplier's design capability	Demonstrated ability to achieve outstanding safety performance.	Viability of Company (Weighting - 5%)
Environmental regulation compliance	Successful public relations and industry recognition.	Installed Equipment Operating History (Weighting - 15%)
Financial capability and stability	Demonstrated practical experience and philosophical approach in the areas of developing ecologically sustainability and environmental management.	Safety (Weighting - 10%)
Production scheduling and control systems, including supplier delivery performance	Demonstrated understanding and affinity for operating as a member of an alliance.	After Sales Service (Weighting - 5%)
Information systems capability (e.g. EDI, bar coding, ERP, CAD/CAM)		Alternative Options (Weighting - 10%)
Supplier purchasing strategies, policies, and techniques		Total Weighting = 100%
Longer-term relationship potential		

4.4 Alliance Framework

“For a contract to be a success, it must be a win-win situation. This means that each party expects to be operating in a profitable mode.”

Respondent from Company 8

The Association of Strategic Alliance Professionals (ASAP) has developed a generic Memorandum of Understanding (MOU) that outlines some of the major topics that should be addressed in an alliance agreement:

- “Purpose of the Agreement
- Spirit of the Venture
- Key Objectives and Responsibilities
- Method for Decision-Making
- Resource Commitments
- Financial Philosophy
- Assumption of Risks & Division of Rewards
- Rights to Products and Inventions
- Confidentiality and Non-Competition
- Anticipated Structure
- Transformation
- Conflict Resolution”⁸⁹

4.4.1 Establishing Goals for the Alliance

Company 12 noted that an important task in any alliance agreement is to align the partner’s goals. Company 11 stressed that clearly defining each party’s expectations of the alliance at the beginning makes a world of difference in the execution of the alliance. There is a need for honesty about the business expectations for the alliance agreement. We will again consider the three broad categories of cost, time and quality performance.

A representative from Company 8 said, “the benefits that the end-user initially perceives are straight cost.” A representative from Company 12 cautioned that conflicts do exist between the Owner’s and EPC contractor’s time horizons in terms of cost. The

Owner is interested in life cycle cost issues that span the life of the equipment whereas the EPC contractor is primarily concerned with the total installed cost of the equipment that focuses on the initial purchase price and installation cost. The CRINE (Cost Reduction Initiative for the New Era) Ernst & Young report summarizes this issue (CRINE was a UK petroleum industry initiative to improve the competitiveness of the North Sea area by finding ways to reduce cost. The CRINE organization has evolved to Pilot, <http://www.pilottaskforce.co.uk/> and Logic Oil, <http://www.logic-oil.com/>):

“3.1.2 Alignment of Objectives: The understanding and alignment of goals amongst collaborating organizations is recognized as fundamental to the success of long-term strategic relationships, though achievement of this is often poorly executed. For example, the ... survey found that Life Cycle Value is most important to operators (Owners), and of successively less importance to contractors and suppliers. In such an instance, alignment of objectives could be secured by total cost incentive-related or life-of-field contracts.”⁹⁰

There was a general perception that time savings were potentially the biggest and best savings on the project. The Owner gets the facility quicker to start production; the EPC contractor can redeploy their assets to another job sooner; and the Supplier can better utilize their resources by minimizing the start and stop cycles common to the traditional procurement process. In general, time savings with alliances were largely attributed to isolating the equipment procurement process (selection, terms and conditions, pricing) from the project schedule to a multi-project, strategic level. Additional timesavings were attributed to pre-agreed engineering specifications and processes to develop solutions to problems.

The questionnaire asked respondents to select quality benefits that they believed were possible with supplier integration for major engineered equipment (Appendix A,

Question 2.6). Most respondents felt that quality would improve with fewer change orders to correct problems during construction, when problems are more expensive to correct, than they are during engineering. A corollary to this benefit is improved detailed designs. Respondents also believed that a better technical solution could be achieved which ties together their belief that improved system and facility performance are quality results of supplier integration for major engineered equipment. See Figure 4-8 for a complete ranking of quality responses.

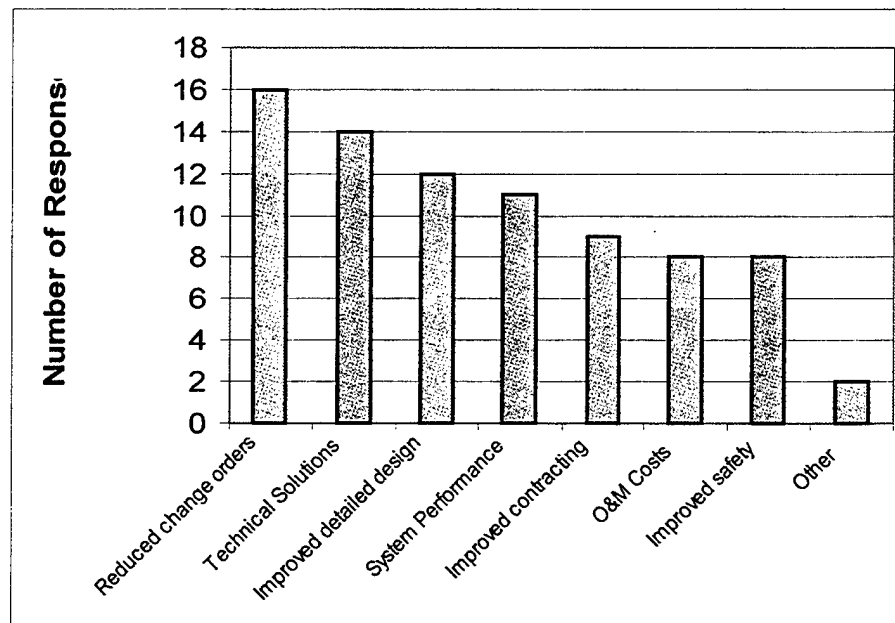


Figure 4-8 Quality Benefits of Supplier Integration

Some Suppliers, Companies 11 and 12, expressed their desire to have greater input on equipment selection. They noted that there are some top performance equipment factors that are typically covered in the specifications for a certain piece of equipment,

but there are also some secondary performance factors associated with this equipment that can affect the overall facility performance that are difficult to capture in specifications. These suppliers wanted to change the way they do business by simplifying the process to lower the cost.

A fourth major category, in addition to cost, time and quality that some respondents highlighted was risk mitigation. This issue was not covered in the questionnaire or interview but was provided by the respondents as additional, relevant information. A representative from Company 12 stated that risk mitigation is just as important as cost when considering an alliance. They felt that a company should answer two critical issues for risk mitigation:

- “Who are you doing business with?”
- “How have you done business with them in the past?”

Company 5, an EPC contractor, was concerned that an Owner’s alliance may not satisfy their project risk profile in regards to terms and conditions.

4.4.2 Defining the Alliance Scope

Several respondents commented that the term “alliance” has a wide range of meanings in real-world situations. A representative from Company 9 commented frankly that the term “alliance” has a negative perception because early agreements were viewed as only benefiting the supplier. Some companies have renamed their alliance agreements to focus on the key aspects of the agreements. Some new alliance names include: “preferred supplier agreements,” “supplier relationship agreements,” “supplier agreement”, or “partnership.”

Based on the findings in the literature review and knowledge gained from the interviews, we have developed a “Capital Projects Alliance Spectrum” model (Figure 4-9) that positions alliances relative to other cooperative business arrangements. The model considers three factors in defining these cooperative agreements: ownership commitment, project commitment, and supply chain integration.

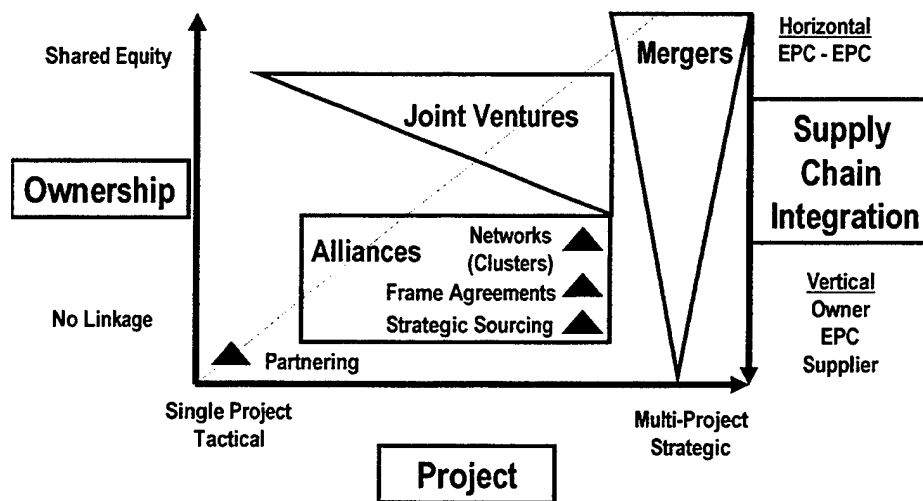


Figure 4-9 Capital Projects Alliance Spectrum

Ownership commitment is a major differentiator between alliances and joint ventures or mergers where partial or complete ownership is a key issue with joint ventures and mergers. Alliances and joint ventures can include single (tactical) or multiple (strategic) project focus. Partnering is viewed only as a single project event on

one extreme and mergers, including a multi-project focus, on the opposite extreme.

Supply chain integration is the third factor of consideration. Alliances, joint ventures and mergers can include horizontal integration with similar type companies or vertical integration with upstream or downstream customers in one's supply chain.

Company 13 noted that there are three types of equipment agreements. The basic level covers an individual product. The next level covers multiple products. The top level is a multiple solution where the Supplier analyzes the process and gives the customer an optimized solution. They felt that the multi-solution process provides the maximum value of supplier's input and the highest level of cost reductions.

Company 13 also noted that the scope of the alliance agreement should also consider geographic reach. If the alliance is for global applications, the supplier should have offices or distributors in all locations covered by the agreement.

4.4.3 Key Aspects

Respondents were asked to rank order the top three contracting tools that could improve the integration of suppliers in large-scale capital projects for major equipment items (Appendix A, Question 4.0). The answers were measured in terms of the total number of responses plus a weighted scoring method. Again, the weighted scoring method simply allocated more points in a reverse order based on the ranking. For example, a number one ranking would be scored as three points, etc. The top five selections based on a weighted score are: cost sharing agreements, target costing, other, total cost of ownership, and long-term contracts. Some observations from "Other" comments to this question included:

- Optimization of equipment design that influences target costing
- EPC Contractors should share more information with Suppliers
- Alliances should develop mutually agreed Objectives, Cultures, and Values.

4.4.3.1 Terms & Conditions

Most respondents noted that the first process to re-engineer with a supplier alliance agreement is terms and conditions. Standardizing contract terms and conditions upfront one time with a supplier alliance will save time on every subsequent project. An employee with Company 5 described their frustration in wasting many hours constantly negotiating the same points of terms and conditions from one contract to the next, even with the same company. If standardized terms and conditions is the “low lying fruit”, what are the barriers to accomplishing this? Company 5 had established several protocol agreements that only addressed standardized terms and conditions, but these contracts were discontinued because they were overridden by project terms and conditions that superseded any other agreements.

4.4.3.2 Standard Specifications

The CRINE Ernst and Young report noted the following additional costs are attributed to over-engineering and the lack of standard specifications:

- A Supplier had “shown that a minimum of 10% of the cost of its service is due to the over-engineering in its customer’s requirements.”
- A “Supplier calculated that being forced to adhere to company-specific specifications rather than using industry-wide ones contributes 8% to their engineering cost.”
- An EPC contractor noted that, “standardization would allow the engineering budget (around 5% of the total costs) to be reduced by up to 30% per annum ... through reduced manpower”

- This EPC contractor also noted that, “lead times could reduce by 25%”⁹¹

Company 8 noted that during the development of their alliance agreements engineering from both parties is involved to develop and agree on standard specifications for the alliance. These are usually an extensively streamlined version of the company’s standard specifications.

Supplier companies 10 and 12 noted that engineered equipment, such as compressors, are not “cookie cutter” designs, but that there would be cost savings attributed to reduced engineering by using previously designed components.

4.4.3.3 Cost Sharing

The range of cost sharing also varied across respondents:

- Company 12 does not share cost savings with alliance partners but offers them volume discounts off fair market value based on sales volume.
- Company 11 noted a key feature in their alliance agreement was that their partner would get the lowest cost for the region where the project was located. This may not be the lowest cost in a global sense because costs vary by regions of the world where projects are executed. This supplier’s approach to price discounts is based on cost reductions from process improvements. In general, this company shares at least 50% of the savings with their partner. They also felt that these savings are actually double because the partner directly benefits from the process savings that reduces cost and also gains any additional benefits such as cycle time reductions that the process improvement generates.

- Company 10 noted that alliances should also include risk management provisions to share in cost overruns when they occur.
- Company 7 uses supplier development to help their suppliers' find cost savings that are then shared. They view this as a constant and on-going process.
- Company 4 highlighted how alliance agreements can also help the Supplier by not having to bid for every job. Giving Suppliers forecast data from the Owner or EPC contractor can improve a Supplier's planning. Company 4 has also created an alliance network that allows alliance partners to buy their supplies from other network partners to help lower everyone's cost base.
- Company 13 noted that their alliance partners should be saving engineering man-hours cost since the supplier is doing more of the engineering in an alliance agreement.

4.4.3.4 Target Costing (Pricing)

While the respondents' ranked target costing as a valuable tool for improving supplier integration, only Company 16 mentioned during the interviews that they are instituting target costing into their engineering to introduce accountability for material budgets and schedules. It is quite possible that other companies interviewed are also using target costing but the research did not highlight this issue.

Target Costing can be viewed as the estimated selling price minus the desired profit. In contrast, traditional pricing is typically derived by taking the products cost and adding the company's mark-up to include overhead and profit. Monczka, et al, note that,

“the challenge is to design a product with the required functionality and quality at a cost that provides a reasonable profit.”⁹² They also note that target costing, “requires a high degree of trust, information sharing, and joint problem solving.”⁹³ A comparison of traditional construction costing and target costing developed by the U.K. Defence Estates agency, which performs a similar role to the U.S. Army Corps of Engineers, is summarized in Table 4.2.

Table 4-2 Traditional Construction Costing and Targeting Costing compared⁹⁴

“Traditional Construction Costing”	“Target Costing”
Costs determine price.	Price determines cost.
Performance, quality and profit (and more rarely waste and inefficiency) are the focus of cost reduction.	Design is key to cost reduction, with costs managed out before they are incurred.
Cost reduction is not customer driven, nor project/design team driven. It is driven by separate “commercial” people.	Customer input guides identification of cost reduction areas.
Quantity surveyors (cost estimators) are responsible for cost reductions.	Cross functional teams manage cost.
Suppliers involved late in design process.	Early involvement of suppliers.
No focus on through-life cost.	Minimises cost of ownership for client.

4.4.3.5 Total Cost of Ownership (TCO)

Although this information was not highlighted during the interviews, respondents still felt that TCO was an important tool to use in improving supplier integration. Hill suggests that TCO analysis will help:

- “Make comparisons among suppliers based on factors other than price
- Negotiate value-added partnership arrangements rather than focusing solely on price reduction
- Identify non-value added activities in the product/service life cycle

- Better understand the spend category's requirements by tracing through the category's life cycle
- Maximize opportunities by looking at the total spend."⁹⁵

4.4.3.6 Contract Duration (Long-term contracts)

The various alliance contract lengths and reasons for the duration also varied by the respondents. As a point of reference, the Kanter study of 37 companies included some alliances that were more than 20 years old!⁹⁶

- For Company 11, most contracts are five years with a clause to renew automatically at the end of the fifth year unless one party decides to end the alliance.
- Company 9 felt that you should review alliance agreements every two years to assess changing market conditions.
- Company 4 uses alliance agreements with three to five year contracts to emphasize the relationship value of the alliance.
- Company 15 has stressed relationship focus with their second generation of alliance agreements that are setup for a 10 year period with a rolling one year contract to ensure performance.
- Company 1 was just establishing alliance agreements and had opted for one year terms because of uncertainties with changing market economies and the desire to collect data to assess the alliance process. They believe that Suppliers are in agreement with this approach because it also allows them to evaluate the alliance relationship.

4.4.3.7 Litigation and Dissolution:

Company 11 noted that they do not include punitive damages in the alliance agreement beyond normal warranty conditions. Unfortunately, this issue was not formally addressed in the questionnaire or interview questions, so additional responses were not obtained. The consulting firm of Booz-Allen & Hamilton suggests that one consider divorce procedures, penalties for poor performance, and arbitration when establishing alliances.⁹⁷ Inkpen and Ross state that, "just as forming an alliance is a difficult process, dissolving and exiting an alliance can also be messy and uncertain."⁹⁸ A respondent from Company 5 believed that it was important for alliances to have clearly defined "off ramps" to exit the agreement.

4.5 Alliance Management and Metrics

"At the end of a contract, performance must be judged by both sides. Hopefully, this is a long term agreement that will continue and improve with time and both parties must be able to respond to problems, accept faults and work together to, in the end have a happy/satisfied customer."

Respondent from Company 8

The goal of alliance management should be to sustain the alliance, modify the alliance when problems are identified, or terminate the alliance if poor performance becomes the standard. A major concern expressed by many companies is that long term alliance contracts could have unforeseen, future negative consequences and there is uncertainty on how to manage risk associated with these consequences. Major concerns expressed by several respondents included:

- The risk of a non-alliance partner developing a new technology that would significantly change the marketplace making you non-competitive.
- Alliance partners developing financial difficulties.
- Determining competitive market prices to benchmark alliance prices.
- Relationship dependency involving high switching cost or over dependence where a partner accounts for a significant share of business.

First and foremost, all of these and any other concerns should be addressed openly and honestly during the development of the alliance. It must also be recognized that all future negative event scenarios cannot be foreseen during the alliance development. A process of how to deal with future problems can be established upfront. The alliance process should not be viewed as static but rather dynamic with frequent communications.

Most companies interviewed said that they have quarterly review meetings with their alliance partners to address issues related to the alliance. Company 8 said that these meetings include senior management and line staff to review goals and establish cost, quality, and health/safety/environment targets. Company 15 uses quarterly overall performance reviews with suppliers using a standardized supplier evaluation process. If poor performance is identified, the company will send a supplier development team to help identify and implement improvements. None of the companies interviewed discussed the dissolution of an alliance agreement.

This study did not address the structure of the alliance management, but an example was found during the literature search that is offered as a suggestion. The National Museum of Australia project organized their alliance management structure into

two groups called the Alliance Leadership Team and the Project Management Team. The Alliance Leadership Team included one or two senior executives from each alliance company that should have authority to make decisions without referring to their management. This group appointed one or two representatives to the Project Management Team who worked together on-site and were responsible for the day-to-day management issues.⁹⁹

4.5.1 Metrics

“If you are not keeping score, you are only practicing.”

- Vince Lombardi

While the majority of companies interviewed in this research have some measurement process in place, a 1999 survey done by Anderson Consulting (now Accenture) found that, “only 51% of companies that form alliances had any kind of formal metrics in place to assess alliance performance.”¹⁰⁰ Inkpen and Ross state that, “if accurate performance measures do not exist, it is because the managers responsible for the alliance have not developed them.”¹⁰¹

Respondents were asked to select their top five measures of performance in rank order. The answers were measured using both the total number of responses and a weighted scoring method. The weighted scoring method simply allocated more points in a reverse order based on the ranking. For example, a number one ranking would be scored as five points in this case, etc. Reevaluating the questionnaire in hindsight, the number of possible choices should have been reduced or the respondents asked to rank order their top six choices to increase the possibility of an answer being selected from 42

percent to 50 percent. The top 5 choices were quality performance, delivery performance, previous history and performance, cost competitiveness, and process technological capability. Figure 4-10 provides additional details respondents' views on performance measurement.

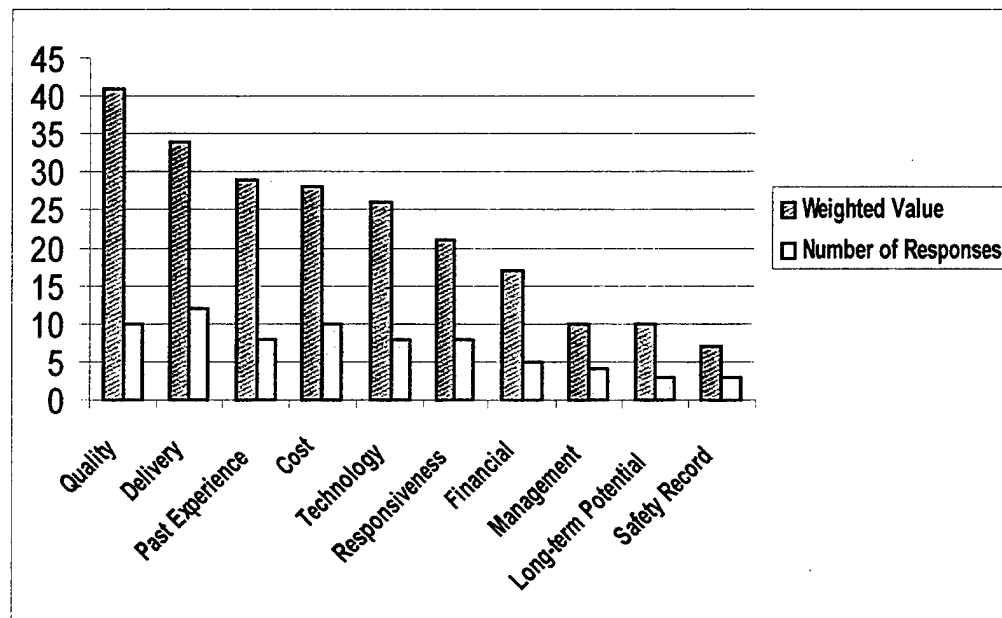


Figure 4-10 Performance Factors

Company 11 noted that measuring results is a “hit” or “miss” process. Some customers are very interested in measuring results and others are not. This company felt that measurements should be done as a way to improve the alliance and not be used for punitive actions.

Company 11 provided some examples of how customers measure them as a supplier:

- Cost savings
- On Time Delivery of the equipment, drawings and documents, parts, support
- Warranty claims (serves as a measure of quality)
- Maintenance Expense
- Time until equipment must be shutdown for overhaul
- Safety

They also noted that Suppliers measure customers to determine the value of an alliance agreement. Some metrics include:

- Variations against standard terms, agreed specifications
- Late changes to equipment specifications
- On-time payments

Performance metrics are used by other companies as well:

- Company 5 measures engineering man-hours because the alliance supplier performs more of the detailed engineering related to their equipment which reduces their direct engineering man-hours for the project. They also measure design quality by tracking redesign work. Alliance suppliers understand their work processes and this reduces redesign.
- Company 7 focuses on measuring total cost of ownership, not merely the initial price. They look at the supplier's service level and how they performed, especially during an emergency situation. They also do a rearview mirror look to see if the initial projected savings and improvements actually materialized.
- Companies 8 and 9 set cost reduction targets that they expect their buyers to achieve. Most were in the range of five to ten percent.

CAPS Research benchmark studies also collected data about procurement performance measures used by Engineering/Construction companies. The results can be found in Table 4-3.

Table 4-3 CAPS Research Procurement Performance Measures for Engineering and Construction¹⁰²

Data Year 2000 ¹⁰³	Companies Utilization Rate
(Internal) Customer Satisfaction Survey	66.7%
(External) Customer Satisfaction Survey	26.67%
Cycle-Time Reduction	40.00%
Price Reduction Targets	66.67%
Cost Reduction Targets	84.60%
Other (Defect-free product; Delivery Performance, Electronic Procurement, Utilization of Corporate Agreements)	26.67%
Data Year 2001 ¹⁰⁴	Companies Utilization Rate
Price performance	86.67%
Delivery	86.67%
Quality	93.33%

Kaplan and Norton developed a “balanced scorecard” method to organize performance measures in a logical way that relates them to the company’s strategy.¹⁰⁵ An example of this scorecard is shown in Figure 4-11. The key insight that the balanced scorecard approach reveals is that companies must measure more than just financial outcomes. The balanced scorecard approach helps them to also consider the perspectives of the customer, internal business processes, and learning and growth (lessons learned) as they relate to the overall strategy and to each other. Bamford and Ernst, with McKinsey and Company consulting, suggest a modified version of the balanced scorecard to focus on financial, strategic, operational, and relationship issues in an alliance. Some of their suggested metrics are listed in Table 4-4.

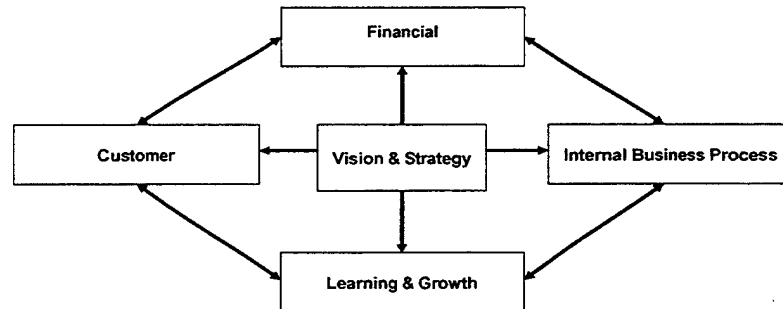


Figure 4-11 Balanced Scorecard¹⁰⁶

Table 4-4 Alliance Scorecard Metrics¹⁰⁷

Performance Dimension	Metrics
Financial	<ul style="list-style-type: none"> • Basics: sales revenue, cash flow, net income, return on investment, expected net present value of an alliance • Reducing cost overlaps • Increasing revenues • Purchasing discounts
Strategic	<ul style="list-style-type: none"> • Market share • New-product launches • Customer loyalty
Operational	<ul style="list-style-type: none"> • Quality of products
Relationship	<ul style="list-style-type: none"> • Trust • Cultural fit • Decision making • Problem solving

5 Summary, Conclusions and Recommendations

5.1 *Summary*

Supplier alliances are a method to improve supplier integration that should lead to lower equipment cost, faster cycle times, and improved quality performance by collaborating with the engineered equipment supplier. Supplier alliances, however, should not be viewed as a blanket solution for procuring engineered equipment items.

A review of the literature showed that all types of alliances have a history of failure, as much as 50 percent of the time. They require resources and time to develop and are difficult to manage since only about half of all alliances have any formal metrics. The literature showed that engineering and construction companies are using alliances less than other companies engaged in capital projects like work, e.g. shipbuilding. The literature also discussed different models and arrangements of alliances.

This study is based on the contributions from 16 companies, primarily engaged in the energy sector. The participating companies represented Owners, EPC contractors, Suppliers and Others to give a broad view of the issue of supplier alliances. International companies were also chosen to provide a global perspective. Quantitative data was collected from 16 respondents using a questionnaire. Interviews were conducted with 32 representatives of the participating companies.

Based on the final analysis of the present situation, it is felt that the most critical contribution of this work is the CaPSAM which incorporates not only the key factors that made supplier alliances successful in other industries, but also measures to avoid pitfalls.

Since synergy leads to better performance, effectively managed supplier alliances are predestined to offer substantive value/benefits to all participants.

5.2 Conclusions

Major findings related to the four Objectives of this study include:

- Three non-energy sector companies engaged in capital projects type work were included in this survey. The literature review found that the shipbuilding industry is using multi-company consortium buying to leverage their group buying power. The shipbuilding industry also has a higher use of alliances than Engineering and Construction.
- Sixteen companies participated in this research. The initial research question was broadly focused on identifying approaches for implementing supplier integration strategies for engineered equipment in capital projects. Based on initial industry interviews with eight companies, it became apparent that supplier alliances were one method being utilized in the industry to implement supplier integration with varying degrees of success. The revised research questions focused on key issues surrounding supplier alliances including: development, measurement, and management.
- Most industry respondents believed that supplier alliances would result in initial price savings on engineered equipment from six to ten percent. Time savings of four to six months are “low hanging fruit” by eliminating the competitive bid cycle for every engineered equipment order covered by a supplier alliance. As the

alliance matures, additional time savings should be generated from developing standardized equipment components that can be re-used on successive projects and eliminate customized engineering. Additionally, supplier alliances provide a method to integrate the engineered equipment suppliers' specialized expertise about the equipment earlier in the EPC process that will result in better technical solutions.

- Based on the result of the extensive surveys, a Capital Projects Supplier Alliance Model (CaPSAM) was developed consisting of several integrated modules led by a Company Self-Assessment which suggests a procedure where a company assesses its own management culture toward alliances. The model follows the life cycle of the alliance from development through management to include establishing metrics to measure performance.

5.3 Recommendations

The following areas are suggested for future research in supplier alliances for engineered equipment in capital projects:

- Additional research should be carried out in other industries involved in capital project type work, e.g. shipbuilding, etc., to learn more about their methods to improve supplier integration for engineered equipment.
- The Capital Projects Supplier Alliance (CaPSAM) model should be tested on actual supplier alliances to develop more detailed case studies and insights.

Some important topics such as engineering cost savings, litigation, risk

management, alliance management structure, and dissolution of alliances were identified during this study but were not addressed to all participants.

- Any of the CaPSAM modules: company self-assessment, business case, supply base management, alliance framework, or alliance management and measurement should be researched in greater detail to develop new tools or assess existing tools for use in these areas. The Dyer study provided a list of tools by stages that are shown in Figure 5-1.

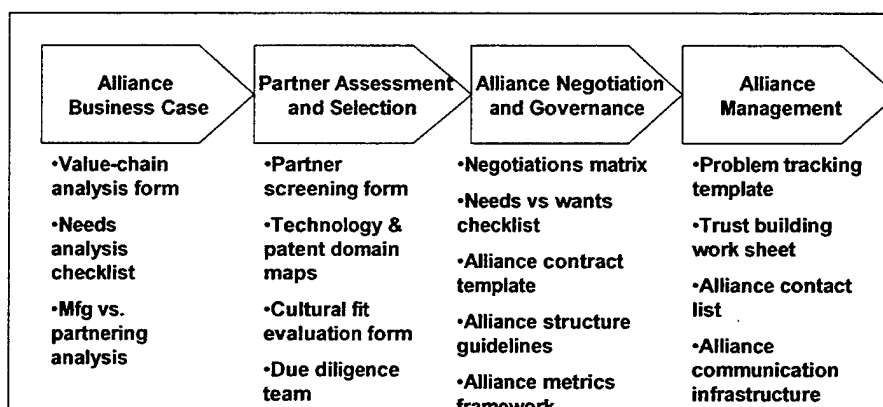


Figure 5-1 Alliance Tools¹⁰⁸

A proposed tool for the Business Case module would be the use of real options to analyze the value of the alliance. Arnold and Shockley used the real options concept to study the value created by Anheuser-Busch using joint ventures to develop breweries in growing foreign markets.¹⁰⁹ Bamford and Ernst also

described how a power industry company used options to create four scenarios based on different technology and construction costs assumptions to value an alliance for developing a new technology. This exercise sensitized this company to possible risk and highlighted the need, “to closely monitor the alliance’s early performance, while reserving the right to cut off funding in the event that technical progress slowed.”¹¹⁰

- Further research on supplier alliance metrics is needed to include: determining what metrics are most useful in managing supplier alliance performance and defining metrics to measure “other” benefits besides time and cost that are associated with quality improvements contributed to the integration of the supplier’s knowledge in the capital projects process.

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APPENDIX A QUESTIONNAIRE

Research Questionnaire
Improving Supplier Integration in Large-Scale Capital Projects
North Carolina State University - Supply Chain Resource Consortium

1.0 General Information

1.1 Purpose: The purpose of this questionnaire is to identify the opportunities, barriers, critical success factors, and key performance metrics necessary to achieve supplier integration in large-scale capital projects. Specifically, the focus of this research is major equipment items accounting for a significant portion of the project budget.

1.2 Goal: The goal of this research is to identify methods that assist the key organizations (owners, contractors, suppliers) involved in large-scale capital projects to deliver greater value than simply lower cost.

1.3 Confidentiality: The information you provide will be maintained in strict confidence. Your responses will be aggregated to develop general statements and trends. Under no circumstances will your direct company information be included in any reports without your express written consent and approval. With your permission, we would like to include your company name and contact person as general information about the participants in the final report. The final report will most likely include publicly available information (e.g. company websites, news articles, etc.) that describe some of the best practices that your company is involved with related to supply chain management.

1.4 Company Information

1.4.1 Company Name:

1.4.2 Point of Contact:

1.4.3 Which industry is your company involved in (please circle all that apply):

☐ Electric Power ☐ Petroleum & Chemicals ☐ Other (please specify):

1.4.4 Please classify your company based on your typical role in large-scale capital projects.

☐ Owner ☐ Contractor ☐ Supplier ☐ Other (please specify):

Research Questionnaire
Improving Supplier Integration in Large-Scale Capital Projects
North Carolina State University - Supply Chain Resource Consortium

2.0 Opportunity:

2.1 Please provide a breakdown (estimated) of the contracting methods your company uses to award contracts for major equipment items. (E.g. low bid – 60%) If you are a supplier, please provide the breakdown of contract types that you are involved with owners or contractors.

Lowest, qualified bid _____ %

Negotiated bid _____ %

Other (please specify) _____ %

Other:

2.2 In what relationship do you think collaboration has traditionally been the strongest in your industry? Please select only one choice.

☐ Owner – Contractor ☐ Owner – Supplier ☐ Contractor – Supplier

2.3 Please select all of the performance metrics that you believe could be improved by integrating suppliers of major equipment items earlier in the project development process:

☐ COST – reducing cost

☐ TIME – improving coordination/
flexibility of long lead items

☐ QUALITY – providing what the
customer wants

☐ NONE – please go to Section 3.0

2.4 Please select all of the project phases where you believe improved supplier integration could reduce the cost of major equipment items. Please also provide a rough estimate (e.g. 1-5%, 6-10%, 11-15%, etc) of the cost savings.

☐ Initial price _____ %

☐ Installation _____ %

☐ Start-up _____ %

☐ Warranty _____ %

☐ Other (please specify) _____ %

Other:

Research Questionnaire
Improving Supplier Integration in Large-Scale Capital Projects
North Carolina State University - Supply Chain Resource Consortium

2.5 Please select all of the project phases that you believe improved supplier integration could either reduce and/or improve a project's schedule:

- ☐ Fabrication schedule (supply vs. demand, supplier backlog, capacity utilization, etc.)
- ☐ Detailed/shop drawing design (minimize approval drawing re-cycle time)
- ☐ On-time, guaranteed delivery date
- ☐ Zero defects with equipment at the job site
- ☐ Trouble-free equipment/plant start-up
- ☐ Other (please specify)

Other:

2.6 Please select all of the additional quality benefits that you believe are possible with improved supplier integration:

- ☐ Deployment of better technical solutions
- ☐ Improved system/facility performance
- ☐ Improved operating and maintenance costs/efficiencies
- ☐ Others (please specify):
- ☐ Improved contracting
- ☐ Improved safety
- ☐ Reduced engineering change orders
- ☐ Improved quality of detailed design

Other:

2.7 Do you believe including key suppliers in Value Engineering would improve quality?

☐ YES

☐ NO

2.8 Does your company have a policy to include key suppliers in Value Engineering studies?

☐ YES

☐ NO

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Improving Supplier Integration in Large-Scale Capital Projects
North Carolina State University - Supply Chain Resource Consortium

3.0 Barriers to Successful Integration of Suppliers:

3.1 Contracts: Please provide an estimate of what percentage of contracts require a specific supplier for major equipment items.

<input type="checkbox"/> 75-100%	(a) <u>Owner:</u> My company already has selected suppliers for a strong majority of major equipment items. (b) <u>Contractor:</u> A strong majority of the contracts that my company is involved with have a pre-determined list of suppliers. (c) <u>Supplier:</u> A strong majority of my workload is based on my position as the pre-selected primary supplier.
<input type="checkbox"/> 50-75%	(a) <u>Owner:</u> My company has selected suppliers for a majority of all major equipment items. (b) <u>Contractor:</u> A majority of the contracts that my company is involved with has a pre-determined list of suppliers. (c) <u>Supplier:</u> A majority of my workload is based on my position as the pre-selected primary supplier.
<input type="checkbox"/> 25-50%	(a) <u>Owner:</u> My company has selected suppliers for a minority of all major equipment items. (b) <u>Contractor:</u> A minority of the contracts that my company is involved with has a pre-determined list of suppliers. (c) <u>Supplier:</u> A minority of my workload is based on my position as the pre-selected primary supplier.
<input type="checkbox"/> 0-25%	(a) <u>Owner:</u> My company has limited selected suppliers for all major equipment items. (b) <u>Contractor:</u> A limited number of the contracts that my company is involved with have no pre-determined list of suppliers. (c) <u>Supplier:</u> A limited volume of my workload is based on my position as the pre-determined primary supplier.

3.2 Company Policy Please provide an estimate of what percentage of contracts requires a competitive bid as a key criterion for selecting major equipment items. If you are a **supplier**, please view this question in regards to your relationship with Owners and Contractors.

<input type="checkbox"/> 75-100%	Company policy requires low bid as a key criterion to select key suppliers of major equipment on most projects.
<input type="checkbox"/> 50-75%	Company policy requires low bid as a key criterion to select key suppliers of major equipment on a majority of projects.
<input type="checkbox"/> 25-50%	Company policy requires low bid as a key criterion to select key suppliers of major equipment on a minority of projects.
<input type="checkbox"/> 0-25%	Company policy does not require or use low bid as a key criterion to select key suppliers of major equipment.

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North Carolina State University - Supply Chain Resource Consortium

3.3 Company Culture Barriers: Please select the **top three (3) barriers** to improving supplier integration. **Please rank order your choices with #1 being the most important.**

- _____ Lack of management commitment to supply chain integration
- _____ Lack of financial incentives (cost sharing)
- _____ Lack of trust
- _____ Individual, group, or organizational resistance to change
- _____ Lack of value analysis – trading cost, time and quality factors
- _____ Inadequate information sharing
- _____ Conflicting goals/objectives between Owners, Contractors, Suppliers
- _____ Other (please specify)

Rank	Other Barriers

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North Carolina State University - Supply Chain Resource Consortium

4.0 Contracting Critical Success Factors: Please select the **top three (3) contracting tools** that could improve the integration of suppliers in large-scale capital projects for major equipment items. **Please rank order your choices with #1 being the most important.**

- _____ Target Costing (working together to achieve a specified cost for an item;
target cost = estimated selling price – desired profit)
- _____ Time Baselines (working together to develop the project schedule)
- _____ Contract terms and selection criteria based on total value/cost vs. lowest cost
- _____ Long term contracts that encourage supplier commitment
- _____ Cost Sharing Agreements that provide financial benefits to all parties
- _____ Others (please specify)

Rank	Other Critical Success Factors

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North Carolina State University - Supply Chain Resource Consortium

5.0 Performance Metrics

5.1 Does your company have a program in place to measure supplier performance? If you are a **supplier**, do you measure the contractors' or owners' performance?

☐ Yes ☐ No

5.2 Please select the **top five (5) factors** that you believe provides the best measure of performance. **Please rank order your choices with #1 being the most important.**

- _____ Financial strength
- _____ Management and personnel capability
- _____ Process and technological capability
- _____ Delivery performance
- _____ Flexibility
- _____ Previous history and performance
- _____ Responsiveness to customer needs
- _____ Cost competitiveness
- _____ Quality performance
- _____ Environmental compliance
- _____ Longer-term partnership potential
- _____ Safety record
- _____ Other (please specify)

Rank	Other performance metric

Research Questionnaire
Improving Supplier Integration in Large-Scale Capital Projects
North Carolina State University - Supply Chain Resource Consortium

Methods to return this questionnaire:

1. Email: dgharper@unity.ncsu.edu
2. Fax: (919) 515-6943 (ATTN: Dr Handfield – Large Project Research Study). If you fax the questionnaire, please send me an email (dgharper@unity.ncsu.edu) so that I can retrieve it from Dr Handfield.

THANK YOU for completing this questionnaire!

APPENDIX B INTERVIEW QUESTIONS

Research Interview
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North Carolina State University - Supply Chain Resource Consortium

1.0 Current Process:

- 1.1** Please describe in general terms the current process that your company utilizes to procure major equipment items for large-scale capital projects (e.g. low bid). If you are a supplier, please describe the processes that you are involved in with owners and/or contractors to acquire your equipment.
- 1.2** Please describe any existing alliance (frame or project) agreements in place with suppliers for major equipment items. Please focus on the history of these deals, process used for their development, their commercial basis, lessons learned, level of success, etc.

2.0 Reengineering the Process

- 2.1** Please list the top three processes that you feel could be reengineered to improve supplier integration in large-scale capital projects. For example: having suppliers' value engineer equipment items, establishing incentive-type or cost savings sharing agreements with suppliers, etc.

3.0 Future Strategies

- 3.1** Please describe your ideas to better involve suppliers of major equipment items in large-scale capital projects in the future.
- 3.2** Please describe any of the benefits you envision from this new process.
- 3.3** Also describe any challenges that you foresee with this initiative.